RAILROAD GAZETTE

SATURDAY, JULY 20, 1872.

THE MASTER MECHANICS' ASSOCIATION.

Official Report of the Fifth Annual Convention.

FIRST DAY.

DISCUSSION ON BOILERS AND BOILER MATERIAL.

[Continued from page 283.]

Mr. ROBINSON, of the Great Western Railway of Canada—Mr. Fry brings to my mind a large number of experiments which I witnessed, with different shaped fire-boxes, when in England. Having studied my business on the London & Northwestern Railway of England, I happened to be on hand when a series of experiments in this connection were going on. At that time, now seventeen years ago, fire-boxes were made and altered into every conceivable shape for these experimental purposes, and any one interested in the subject who may have been on English railroads during that period will remember with amusement how much money was spent in getting up and destroying the various devices.

No expense was apparently spared to test the important subject. Fire-boxes were widened at the bottom, and water partitions were introduced in every conceivable shape. Mr. Cudworth's long, inclined fire-boxes, mentioned by Mr. Fry, were adopted on some roads in various ways.

On the road I was connected with, among the many peculiar positions of fire-boxes tested, one was tried with the grates laid like a staircase or steps inclining from the fire-door to the tube sheet. The notion in this form of grate is, that the green coal should be supplied at the highest end to be shaken down by the motion of the engine; but notwithstanding the inclination of the grate it was found that the soft coal, especially if small, became cemented together and had to be broken by a poker or iron bar and pushed down, which duty by degrees became neglected by the firemen, and thus unsatisfactory results were the consequence of it. Mr. McConnell, of the London & Northwestern Railway, introduced longitudinal water partitions down the centre of the fire-box and extended the fire-box into about one quarter the length of the barrel; the intention being that the firemen should fire each side of the partition through two independent fire holes alternately, and that combustion should take place in the chamber in the barrel of the boiler. Mr. Beatty, of the London & Southwestern Railway, tried similar plans, with the addition of a complicated arrangement of bricks. Mr. D. K. Clarke used hollow stay-bolts above the level of the fire and forced air into the furnace by means of jets of steam from the outside, in the manner of a series of air injections. All these, and many other plans of lesser note, I lived in England long enough to see abandoned, after obtaining more or less good results, varying from 7 to 10 pounds of water evaporated per pound of fuel, according to state of engine. But the greater value of simplicity of wearing parts becoming apparent as these experiments progressed, they were replaced pretty generally by the simple old form of fire-box, in which was introduced either the brick arch under the tubes, or a deflecting plate through the fire door, and in some cases both are used with good results. In connection with these a blower in the smoke-stack is used to help when in towns or cities, to consume the smoke, which with the other combined appliances is generally successfully accomplished. Mr. Ramsbottom, late of the London & Northwestern Railway, placed the brick arch inclining downwards towards the fire and forwards, and admitted the air in special air doors under the brick arch through the fire-box plates under the tube sheet. This plan, I believe, works very satisfactorily both in economy of fuel and consumption of smoke. About seven years ago the engines under my care were necessarily supplied with such green wood that I had to resort to coal, which caused me to renew my inquiries upon the subject, when I got up plans and made what might be called a "hot air leg," to be used similarly to the brick arch or water leg.

This was made of cast iron, hollow, like a water leg, and perforated on the under side. At the lower end under the tube sheet were holes corresponding with similar holes through large hollow stay-bolts or tubes, through which the air was admitted under the barrel of the boiler and regulated by a slide worked from the foot-plate. It so happened that just as these plans were perfected a good supply of dry wood was again furnished and coal abandoned, rendering the experiment useless so far as my road was concerned, for the time being; but should the idea meet with the approval of any of our members, I may here state that it is entirely free and at their disposal; and feeling convinced that it has merit worthy of further investigation, I hope those using soft coal will give it some consideration.

The third question was read, and on motion of the Secretary, laid over until the report of the Committee on Straight and Wagon-top Boilers should be received.

Mr. HAYES, Illinois Central Railroad—It seems to me that those two things were complicated. As I understand it, we were a Committee on Boilers and Boiler Materials. Now, *boilers*, as I understand it, includes all kinds of boilers, and I supposed we were to cover that ground; hence I see no need of another Committee on Straight and Wagon-top Boilers. If we were a Committee on Boilers and Boiler Materials, I should suppose we were to take in all kinds of boilers with which railroad mechanics are familiar, both stationary and locomotive.

The SECRETARY—The subjects and committees all came to me just as they are given, and it was suggested to the President that some of the subjects might perhaps conflict a little; but we did not feel as though we ought to alter the arrangement at all, and it was not done.

The next question was read by the Secretary, as follows: "What diameter of flues do you advise for use in wood and coal burning engines?"

Mr. ELLIOTT, Ohio & Mississippi Railroad—Mr. Benton has had some experience with 2¼in. flues.

Mr. BENTON, Indianapolis & St. Louis Railroad—I would state that the experience I have had with a certain kind of coal is in favor of the 2¼ as against the 2in. tubes. With the soft coal we get in Illinois we find great difficulty in using 2-inch tubes; but with the block coal, which burns freely and which we get in Indiana, we have no trouble. Taking the sum of all the experience I have had, I am in favor of the 2¼in. tubes for coal.

COMMITTEE ON SUBJECTS FOR DISCUSSION AT NEXT CONVENTION.

Mr. CHAPMAN, Cleveland & Pittsburgh Railroad—I wish to call the attention of the meeting to the recommendation of the President for the appointment of a committee to whom subjects for future discussion may be referred, that they may be able to report early. I move that a committee of five be appointed to select subjects for the next annual meeting.

Agreed to, and the committee appointed as follows: Boon, Pittsburgh, Fort Wayne & Chicago Railway; Forney, of the RAILROAD GAZETTE; Perrin, Taunton Locomotive Works; Robinson, Great Western Railway; Smith, South Carolina Railroad.

Mr. FLYNN—I would like to suggest to that committee a subject of inquiry which would be of interest to us, and that is, the economy of the use of coal as against wood. In some portions of the South, before long, we shall be compelled to use coal, and it would be an interesting subject of inquiry to us to know what price wood should reach to make the use of coal more economical.

Adjourned to 9 o'clock, June 12.

SECOND DAY.

The Association was called to order at 9.20 A. M., Wednesday, June 12, by the President, and the discussion upon the report of the Committee on Boilers and Boiler Material was resumed. The eighth question, do you advise drilling instead of punching the rivet holes in boiler plate, and answer were read.

DISCUSSION ON BOILERS CONTINUED.

Mr. HAYES, Illinois Central Railroad—The Committee found that there were a great many master mechanics who said that they believed drilling was better than punching, but they had made no experiments. Hence the Committee were in the dark upon the subject, and made a series of experiments in order to get light, the result of which are embodied in the report.

By request the Secretary read the portion of the report referred to as follows:

"A large majority of master mechanics from whom we have heard advise drilling instead of punching rivet holes in boiler plate. No tests of their relative strengths were reported, and your Committee, therefore, felt compelled to experiment in order that definite information might be given you.

"The following tests were made, all the pieces being from the same sheet:

"Three pieces of 5-16 in. boiler plate, 1¾ in. wide, were torn in two by hydraulic pressure.

No. 1 broke under a strain of	32,228	lbs.
No. 2 " "	32,228	"
No. 3 " "	33,600	"
The average breaking strain being	32,685	"

"Three pieces of 5-16x1¾ in. plate were *punched*, one ¾in. hole being put in each piece. They were then subjected to a tensile strain, with the following result:

No. 1 broke under a pressure of	13,371	lbs.
No. 2 " "	13,371	"
No. 3 " "	13,714	"
The average being	13.485	"

"Three pieces of 5-16x1¾ in. plate were *drilled*, one ¾in. hole being put in each piece.

No. 1 broke under a pressure of	17,828	lbs.
No. 2 " "	17,485	"
No. 3 " "	17,622	"
The average being	17,645	"

"The average strength of the drilled plate being 4,160 lbs. greater than that of the punched plate.

"Great care was taken to dress the pieces to the sizes given after they were punched or drilled.

"The following comparative tests were then made with punched and drilled plates riveted:

"Six pieces 1¾in. wide, and cut from the same sheet as the foregoing, were punched and riveted together, in pairs, with the best ¾in. rivets, one rivet to each pair, and were subjected to a tensile strain, with the following result:

No. 1 broke in center line of hole under	17,828	lbs.
No. 2 " " " "	17,828	"
No. 3 " " " "	17,143	"
The average breaking strain being	17,599	"

"Six pieces, duplicates of those last mentioned, were *drilled* and riveted together in pairs, one ¾in. rivet to each pair.

No. 1 sheared the rivet under a pressure of	17,143	lbs.
No. 2 " " " "	16,457	"
No. 3 " " " "	15,428	"
The average shearing strain being	16,342	"

"You will observe that the rivets securing the plates having drilled holes were sheared under a less pressure than was required to tear asunder the plates having punched holes.

"It is also worthy of note that while the punched plate is weaker than the drilled plate, the rivets in the punched holes do not shear so easily as those in the drilled holes. This is probably due to the edges of the drilled holes being sharper and more compact, and consequently more capable of shearing than the edges left by a punch. It is not probable that the tensile strength of boiler plate, per square inch of section, is impaired by drilling, but your Committee is satisfied it is impaired by the use of a punch.

"In view of these facts, we advise drilling the rivet holes for longitudinal seams of boilers; the circular seams are not subject to so great a strain and may be punched. We also advise the use of ¾in. rivets, 1¾in. from center to center, for all seams in locomotive boilers made of ⅜in. iron, as the ¾in. rivet is too small to resist a shearing strain equal to the tensile strength of the plate between the rivet holes when they are drilled."

Mr. ROBINSON, Great Western Railway—I would like to ask Mr. Hayes whether the gentlemen who made these experiments formed any opinion, or made any estimate as to the difference in cost between drilling and punching the holes in manufacturing a locomotive boiler?

Mr. HAYES—There was no estimate made of the cost, but Mr. Robinson and every other master mechanic can very easily judge what the difference would be. A man could probably punch three holes while he is drilling one. But the number of holes we recommend to be drilled in a boiler is not very large, and hence the increase in the cost of the boiler would not exceed twenty-five dollars.

Mr. FORNEY, of the RAILROAD GAZETTE—It seems to me that if the conclusion to which the Committee have arrived is correct, that the strength of the punched portion of a boiler plate is 30 per cent. stronger if it is drilled than it is if the holes are punched, it is an extremely important fact, and one to which a great deal of attention should be paid. I know that many have doubted whether there is so great a difference as the Committee state. I merely wish to impress upon master mechanics the importance of paying due attention to this fact. It was stated here yesterday that in England the boiler makers had abandoned drilling boiler plates. I happen to have here the specifications of some engines that were built in England, from which I will read an extract: "The longitudinal seams are all double-riveted, with butt strips inside and out, the latter being countersunk to enable the rivets to fill the holes well up * * * *All the holes in the boilers are drilled*, and all the edges of the plates planed." It appears, therefore, that in some establishments in England, at any rate, they are still drilling boiler plates, and seem to realize the importance of doing so.

Mr. HUDSON, Rogers Locomotive Works, Paterson, N. J.—I think the question of drilling or punching plates hinges rather upon some other considerations than merely the relative strength of drilled and punched plates. We want to know the facts in regard to boiler explosions, and where the sheets generally give way. Do they give way tearing from hole to hole, or do they give way on what we ordinarily call the caulking edge? My own impression is, from the opportunities I have had to examine boilers that have exploded, that they rarely tear apart from hole to hole, but that the sheets gradually give way or break at the caulking edge, from the bending backward and forward of the sheet from time to time as the boiler is under strain. In one or two cases I found, in a length of twenty-four inches—taking it along the caulking edge, in a direct line—that there was not three inches of solid iron left. We have avoided that difficulty, in constructing our boilers, by putting a welt piece around, lapping it on the inside, extending over the edges of the sheet in each direction—the direction of the caulking edge and the other edge. The rivets go through this additional piece, and are staggered on each side, this additional piece being thinned at the edges, so as to make the strain gradually die away, and not be concentrated on the caulking edge. If neither punched nor drilled plates give way through the holes, then it is not a question whether it is better to drill or punch them, because, if they do not give way there, it is an immaterial matter; but the question is the strength of the boiler where it gives way.

Mr. GREGG, Erie Railway—The experiments which have been made are evidently very important to us, as master mechanics, but I think they have not gone quite far enough. If I understand the experiments, they have proved very clearly that the drilled sheet is the stronger of the two; that is, the drilled sheets stand the heaviest tensile strain, by several thousand pounds. But at the same time they show that the rivets shear in the drilled sheets under a much lighter strain than the plates break of the punched sheets; showing that, if put together with the same size of rivets, the drilled sheet is really much the weaker sheet. The experiments, perhaps, have not been continued far enough to determine what increased size of rivet the drilled sheet would stand, as compared with the punched sheet, and how much greater strain the drilled sheet would stand when the rivets were increased in proportion to the strength of the sheet, as compared with the punched sheet. When that point is determined it will be seen how important it is to drill sheets instead of punching them. It will increase the expense to drill rather than punch. I am very glad to know that these experiments have been carried so far, but it seems to me, as I have said, that they have not been carried far enough, since that fact has not been decided.

Mr. FORNEY—In regard to what has been stated by Mr. Hudson, his experience and observation have been very much more extensive than my own and therefore much more worthy of weight than what I have observed, but my experience and observation have shown that more boilers give way through rivet holes than along the line of the seams. But even supposing what he states to be correct by using a covering-plate or welt-piece, you obviate that difficulty of the bending of the sheet close up to the caulking seam. If that difficulty is obviated, it would seem to indicate that a boiler must be a great deal stronger if you drill the plates. The English people, as I have seen from books (and probably there are some gentlemen here who have had experience on the other side), are making a great many boilers with butt joints, by putting a covering plate inside and another outside, so that there will be no tendency to bend the sheet close to the caulking seam. The danger from that cause of rupture is in that way avoided. Therefore, if you drill the plates, the strength of the seam must be very much increased.

There is another feature in regard to the drilling of plates which seems to me very important, and that is matching the holes. We all of us know that in ordinary boiler work it is extremely difficult to make the holes, when they are punched, meet accurately. They will vary a thirty-second or even a sixteenth of an inch. The result is, it is almost impossible to make the rivet fill up the hole, and consequently an undue strain will come upon some of the rivets, while upon others there will be very little strain. In that case, there is danger of shearing off the rivet upon which the extra strain comes, and bringing a strain upon the adjoining holes and thus starting a rupture, which will ultimately result in the destruction of the boiler. Now, in drilling plates, the holes can be made to match exactly if the plates are drilled together, and therefore each rivet will do its due proportion of the work and no greater strain will be thrown upon one than the others.

I think that careful experiments in regard to this matter would be extremely interesting and valuable. I suppose there is hardly a member of this body who has not had occasion to see the dreadfully disastrous results which have followed from boiler explosions. In considering this subject, therefore, we are not merely looking to the saving of money to the people who employ us but to the saving of human life. Therefore we ought, I think, to give great attention and due weight to all facts and experiments bearing upon this question.

In the discussion yesterday, nothing was said in regard to the quality of the material used in the stays. I am very well satisfied that the reason why stays and braces so frequently give way in boilers is that poor material is used in that portion of the boiler which should have probably as good material as any other portion, and perhaps better.

Mr. HAYES, Illinois Central Railroad—The subject of stays is discussed in the report, and, of course, will be brought up in due time. Although I believe it is not contained in the question, I may state now that in one case mentioned in that report, in examining an old boiler, we found forty stay bolts broken off, pretty much in the same place, near the top of the furnace. Ascertaining that we were liable to have explosions from that cause, we then experimented somewhat upon this question of stay bolts, and put the results of our investigations into the report.

Mr. BROWN, Erie Railway—Is not the fact of the rivets in punched sheets resisting a greater strain than those in drilled sheets due to the fact that in the punched sheets you change the plane of the surface iron, and in driving the rivets, the imperfections are driven into each other, thereby resisting greater strain?

Mr. PHILBRICK, Maine Central—As to the question where boilers give way, my experience is not large, but I have examined several cases carefully, and in examining a case of explosion, I think I have generally been able to detect the first starting-point, and then the successive ruptures as they went on. I do not know that I ever found a rupture to start in sound iron around the rivets. I have found them to break through the rivets, afterward evidently, but they started at some other point, either the caulking edge or some other point, the rupture then continuing through the seams and breaking between the rivets. But had that weak point not occurred there, I have no reason to suppose it would have broken through the sound riveting. So far as I have been able to judge, the starting-point of ruptures is generally quite a weak point. They are caused by the spring, on account of the vibration, or by the unequal expansion, carrying one by the other, so as to weaken it until it gives way. Generally it is quite thin. From that point you can't tell where it will go.

Mr. HAYES, Illinois Central Railroad—We all know that a riveted seam is only about 56 per cent. of the full strength of the iron. Now, if we know that we have a weak point there, a point that has only 56 per cent. of the strength of the balance of the boiler, why do something to make that weak point still weaker? Why not do something to make it stronger? In drilling sheets, using rivets of the proper size and putting them at a proper distance apart, are we not doing a benefit to the public and to the railroad world? If we can do anything that will save expense upon railroads, save lives, and make our boilers last longer, is it not better for us to do it? We all know that the seam of a boiler is its weakest point, and hence anything that we can do to strengthen that weak point is an advantage.

Mr. ELLIOTT, Ohio & Mississippi Railroad—I think Mr. Hayes has hit the exact point to which we should give particular attention. The experiments of the Committee seem to have demonstrated that we gain, by drilling the seam of a boiler longitudinally, about 30 per cent. Certainly, that is something to gain. Now, the strain that a rivet shears at is very near the strain at which drilled sheets pull apart, and, therefore, by drilling the longitudinal seams we gain an amount of strength equal to the strength before the rivets in a punched sheet give

way, beyond the strength of the sheet. Therefore, there is a point demonstrated by these experiments that is worthy of consideration. It is of little consequence for us to know why a rivet will shear quicker with a drilled sheet than it will with a punched sheet, in comparison with the other fact, that by drilling our sheets we gain 30 per cent. of strength.

Mr. HUDSON, Rogers Locomotive Works—While I agree generally with the idea that it is very important to make boilers as strong as they can be made in every way, still I think, as I said before, that we want to look for the weakest point first. We do not want to look for that point which is not the cause of boiler explosions. I do not wish to be understood as stating that it is better to punch plates than to drill them, but I do wish to state that I think the difference between punching and drilling will not materially tend to prevent the boiler's giving way. They do not give way, as I have said, in my experience, through the rivet holes, nor from the shearing of the rivets. The giving way commences, in the first place, at the weakest point of the boiler, wherever that may be; and we may generally look for that weakest point where the laps are and in the neighborhood of those laps. That the strain may be intensified by injudiciously staying some other part of the boiler, causing undue working and throwing an undue strain upon that point, I have no doubt, but I have no hesitation in saying that I have generally been able to detect, in the boiler explosions that I have had an opportunity to examine, where the boiler commenced to give way; and I must say that I never found a case where the appearances indicated that it gave way through the rivet holes first, but always in the neighborhood of the termination of the laps either at the caulking edge or the other edge of the sheet. Therefore, I think it is important that we should understand that the great point is to strengthen the weakest point of the boiler. Is the weakness due to the punching, or would it materially strengthen this portion of the sheet, in the neighborhood of the caulking edge, to drill the holes? If so, then let us drill them. But I cannot see that it would make any material difference in that respect; and therefore, I say, while I have no objection to drilling—it is simply a question of cost—it appears to me that doing that would not materially strengthen the boiler. If the boiler gives way through the rivet holes, owing to the increased strain brought upon the iron from the punching, then it is important to drill; but, according to my experience, such is not the fact.

Mr. PHILBRICK, Maine Central—Will the gentleman tell us about what proportion of the iron sheet gives way, according to his experience, at the time of the explosion? About how thin has the iron become before giving way at the time of the explosion?

Mr. HUDSON—In those cases that I have examined, not one-quarter of the iron has remained in the condition in which it was originally; that is, with regard to its thickness or with regard to its freedom from cracks, and being broken by being bent backward and forward. In some cases this weakening is caused by what is called "furrowing." If the laps, or seams, are below the water, and this straining takes place, then chemical action eats away the iron, and you have a thin place there, and of course an additional bending takes place there, because we all know that these vibrations and changes occur at the place where there is a difference in section—the increase or diminution of the vibrations takes place there. I say, therefore, that these are the points we want to strengthen. It would be far better, I think, if we could get cylindrical pieces made, as tires are, for the cylinder parts of boilers, without any seams at all, except the round seams, because we should then have no part weaker than the other; but in the absence of these, we want to do the best we can, and hence we want to make the best laps we can. I believe the English practice of making butt joints in the cylinder part, and putting a welt piece on the inside and outside, so as to have a perfect cylinder, is better in some respects than our practice, because it gives strength to the iron in the direction in which the strain upon the boiler does not tend to bend it backward and forward. It then depends upon the holding rivets, upon the welt pieces, and how tightly they are drawn together, and what shearing strain is brought upon the rivets. We very rarely hear of boilers giving way through the rivet holes. I was in England a year or two ago, and had an opportunity to examine several boilers that had exploded, and I found it was owing to furrowing. But that furrowing rather indicates that there must have been some disposition to yield in the sheets. The sheets were put together in the manner of which Mr. Forney has spoken, and the furrowing took place in these sheets on a line with the welt piece, and hence that became the weakest part.

Mr. HAYES—Supposing you have a boiler, with a cylinder of any given length, and stay the heads so you are sure they will not give way, and rivet the seams longitudinally, in the ordinary manner, and subject it to hydraulic pressure, where will it give way?

Mr. HUDSON—If the ends are properly stayed, it will give way about the center of the length.

Mr. HAYES—I mean will it give way at the seam or in the solid part of the iron?

Mr. HUDSON—As I said before, if the seam is what we term a large lap, a turned seam, if it gives way at the edge of the lap, it gives way through the seam; but that is not through the smallest section of the iron.

Mr. FRY, Grand Trunk Railway—I think we are not treating our Committee fairly. As I understand it, they were asked to report upon the relative merits of drilling holes and punching them; they were not asked to determine in what way explosions take place. Nobody can doubt that it is an advantage to have our boilers equally strong in every part. If we make our boilers as strong as they can be made, and then find that they burst from injudicious staying, we may carry the experiment further and find out whether there is not some better means of staying than we now practice. I think our discussion should be kept strictly to this point, whether a drilled or a punched boiler is the strongest; and then, thanking our Committee for the very careful experiments they have carried on, possibly we may request them to go further and inquire whether the cylindrical boilers spoken of by Mr. Forney are any better than the lap-joints in use.

The PRESIDENT—I think Mr. Fry is quite right. In all our discussions we should confine ourselves to the questions and answers of the Committee.

Mr. BROWN, Erie Railway—I think our Committee deserve great credit for the experiments they have gone into. They have demonstrated that a drilled plate is 30 per cent. stronger than a punched plate. One of the members has suggested that they have not gone far enough. They have given us a rule by which we can all work. Take 30 per cent. of the increased strength of the punched plate and add it to the strength of the rivet, and you increase the maximum strength of the boiler seams to over 70 per cent. of that of the plates.

Mr. HUDSON—I did not wish to throw any discredit upon the report of the Committee; I appreciate their labors as highly as anybody else. I merely wish to draw attention to the real facts in the case. I do not want that we should deceive ourselves.

Mr. FORNEY—I am not quite ready to abandon the fact, that boilers do frequently give way through the rivet holes. I happen now to recall a case, which was not a boiler explosion, but an explosion of the air reservoir for the atmospheric brake, which blew the head off, and tore through the entire seam, all the way round. It broke through, I think, every single rivet hole in that seam. I also recall a boiler which I interviewed the other day in Hartford, with my friend Mr. Little, that was exploded, and I think nearly every rivet hole in the circular seam next the smoke-box was broken through. It was also broken through the solid sheet in several places, but the greater part of the breaking was through the rivet holes. Many gentlemen here present, of course, have had opportunities for observation in this matter, much more extensive than my own, and it would be extremely interesting, and very valuable, if we could learn some accurate facts in regard to this point. I have no doubt that boilers do frequently give way owing to the bending of the iron next the caulking seam; but as Mr. Hudson's opportunities for observation on these points have been much greater than my own, his testimony is of course the most valuable.

Mr. SETCHEL, Little Miami Railroad—I desire merely to add my testimony to Mr. Hudson's in regard to the explosion of boilers. I have never yet seen an exploded boiler where the appearances indicated that the rupture commenced on the rivet. We had five new boilers come on the road about the same time, and in less than three months one of them exploded. They gave way where the wagon-top joined the side sheets, by this working. You could see that, for about eight inches on the inside, the iron was black. I examined it soon after it gave way, and could see that the iron had been blacked, and had corroded so that there was not one-quarter of the iron holding when it gave way. It was then thought best to make an examination of the others, and as steam had been noticed coming out round the wagon-top of one of them, we took that engine off, took off the wagon-top and fired the engine up, and a gentle tap of the hammer started a crack in that boiler of at least two inches, right along in the same place. We took the whole five in, and there was not one that had not started right there in that seam. There was a long connecting rod from the wagon-top to the boiler, and no tie-rods at all, and the working had broken the metal off so that it exploded. All the boilers that I have ever seen give way, especially in the cylinder part of the boiler, gave way at the seams first.

Mr. GORMAN, Toledo, Wabash & Western Railway—In speaking of boiler explosions, it seems to me we are losing sight of the fact that there are two different kind of things that we call explosions. They all seem to be explosions, but I do not think one out of ten of the boilers that give way can properly be called explosions. There is as much difference between the explosion and bursting of a boiler as there is between day and night. There is a *bursting* and an *explosion*. I claim that all these things are burstings.

Mr. TOWNE, Hannibal & St. Joseph Railroad—I would like to inquire of Mr. Setchel how they were fastened to the frame, whether rigidly, or with an expansion piece, so as to allow the boiler to work in the frame?

Mr. SETCHEL—The boilers were not fastened to the frame at all.

Mr. ROBINSON, Great Western Railway—I think we are wandering from the subject. There is a paper with questions and answers on the subject of boiler explosions; we can burst out there if we want to burst. But the subject in hand is the relative merits of punching holes and drilling them. I think Mr. Hayes has hit the right point there. The question is, if you take a new boiler and fill it full of water, and put on the force pump, where will it burst? I think that anyone will find that longitudinal seams are very much inferior in strength to circular seams; therefore, I, for one, thank the Committee most heartily for the experiments they have made in this matter, and I feel relieved myself, because I have thought that drilling a boiler all over was the best plan. If we arrive at the best result by simply drilling the longitudinal seams, we save half the labor. We know that in England they are making butt joints. The last time I was there I found they were welding the longitudinal seams. That, to my mind, is a perfect boiler. The closest approach to welding is undoubtedly drilling the plates and making butt joints, with a strip inside and outside the sheet. That is the nearest approach to a welded boiler. If we cannot afford to do that, the next best thing is to drill the holes, and make them as we do now. There are four steps. The first step is to punch the holes and lap them. The next is to drill the holes. The next is to place them joint to joint, still drilling the holes. The next step is to weld the sheets. This is a matter of opinion, after all. We shall probably go home—I shall, at any rate—and chew it over as a cow does her cud—think the matter over until we are satisfied as to the best method to be adopted. It is almost a purely scientific point. I think we should all thank the Committee for what they have done, and be more inclined than otherwise to accept their experiments as the guiding points of our opinion in this matter.

On motion of Mr. Philbrick, Maine Central Railroad, the next question (10th) was then taken up.

"10th. Please state the material and thickness of the thinnest front and back flue sheets you have used with safety in boilers of coal-burning locomotives?"

"We think back flue sheets should be ¼in. thick if of iron, and $\frac{7}{16}$in. thick if of steel; front flue sheets ⅜in. thick if of iron, and ⅜in. thick if of steel."

Mr. ELLIOTT, Ohio & Mississippi Railroad—I would like to state that my ideas are just the reverse as regards thickness. I have been using three-eighths steel sheet for the fire-box sheet, and half-inch for the front sheet, in order to give stiffness, and withstand the caulking of the flues. I put the stiffness in the front of the sheet, and reduce the fire-box sheet, in order to get the seam on the fire-box sheet under the blast and carry the heat off freely. We find no trouble, and we think we get as much strength, because we think the staying of the flues does not extend through the sheet more than three-eighths of an inch, and we think that is fully as good as the plan of riveting.

On motion of Mr. Sandford, the 11th question and answer were read.

"11th. Can you suggest any advantageous changes in material or the construction of locomotive boilers?"

"In the various communications received from master mechanics, no changes of importance were suggested in the material or construction of locomotive boilers.

"Your Committee have one recommendation to make, and that is in regard to stay-bolts for locomotive furnaces. We strongly urge the advisability of using hollow stay-bolt iron exclusively, so that if a stay-bolt breaks partially or entirely, it will be discovered immediately.

"The objection may be made that too much cold air will be admitted in the furnace. This, however, can be readily avoided by driving suitable plugs into the inner end of the holes in the stay-bolts. A boiler recently examined was found to have 40 broken stay-bolts. The boiler is 2½ years old, and is stayed with ⅝in. bolts, 4½in. from center to center. Another boiler was found to have 15 stay-bolts broken.

"Similar instances are numerous, and we think safety demands some surer way of detecting broken stay-bolts than that of getting in the furnace and sounding with a hammer. An examination of this kind is rarely made unless an engine is in the shop for repairs; and consequently boilers often run in an unsafe condition, on account of hidden defects of this character.

"The remedy we suggest is thoroughly reliable. In order that you might have definite information of the strength of ⅝in. hollow stay-bolt iron, your Committee tested the tensile strength of three pieces.

"The hole through the center was $\frac{7}{16}$in. in diameter, and the sectional area of the metal $\frac{1}{10}$ of a square inch.

No. 1	broke under pressure of	28,457 lbs.
No. 2	" "	29,828 "
No. 3	" "	30,171 "
	The average being	29,485 "

"By experiments made a year ago, and submitted to this Association, we found that ⅝in. stay-bolts tapped into ½in. plate, and riveted over, pulled out under an average pressure of 21,486 pounds, which is 8,000 pounds less than the tensile strength of ⅝in. hollow stay-bolt iron.

"It is certain, therefore, that the strength of ⅝in. hollow stay-bolts is more than sufficient to resist the strains to which they will be subjected, if placed 4½in. from center to center."

Mr. EDDY, Boston & Albany Railroad—I like the idea very much of putting in the hollow stay-bolts. I simply rise to ask one question, Why it would not be better to plug them outside rather than inside, because if they break then, it would simply blow the water inside the fire-box and put out the fire; whereas, if they blew outside, when people were standing round, as they often are, it would be likely to do damage.

Mr. LITTLE, of Philadelphia—Why would it not be better, instead of plugging, to use the plan that has been adopted recently by the Messrs. Day, in Philadelphia, in putting in their stay-bolts, that is, having small holes through the stay-bolts, and in riveting it over, close that aperture almost entirely.

Mr. ELLIOTT, Ohio & Mississippi Railroad—I would like to state some little experience I have had the last two years in the use of stay-bolts. We have changed the gauge on our road, and we had, of course, to change a great many engines. We had a number of them two and a half years old, and in getting out the stay-bolts we found we could knock out the inch tubes—those hollow stay-bolt tubes an inch in diameter—very much easier than we could the seven-eighths stay-bolts. They were all sound (the engines had been running and in pretty heavy service), but it took very little to break them, so as to get the sheets apart.

Mr. HUDSON—I apprehend the question of hollow stay-bolts hinges somewhat upon how the hollow stay-bolts are made. So far as my experience goes, we have tried two ways, and out of those two ways we only find one reliable. In other words, hollow stay-bolts made in the shape of tubes we do not find reliable, because they are made by two or three thicknesses, one drawn over the other, and they are not always perfectly welded. We have had occasions where we could strip them apart, take off the outside and break it in two, and break the other apart, showing that the strength of that stay-bolt was merely the section on the outside. We find that the only reliable way to make hollow stay-bolts is to drill them out. I would like to know if there is any better way, because it is a great deal of trouble and quite expensive to drill them out.

Mr. ELLIOTT, Ohio & Mississippi Railroad—I move that the thanks of the Convention be tendered to the Committee on Boilers and Boiler Material for the excellent report they have furnished us.

This motion was adopted, and the next report taken up.

THE RELATIVE MERITS OF THE STRAIGHT AND WAGON-TOP LOCOMOTIVE BOILER.

American Railway Master Mechanics' Association:

GENTLEMEN: The Committee appointed by you on the "Relative Merits of the Straight and Wagon-Top Boilers" report as follows:

We have received answers to questions in circular from twenty-six master mechanics out of about three hundred sent out.

Answers are as follows:

19 prefer the wagon-top boiler.
7 prefer the straight.
9 report having boiler cracked over wagon top.
14 report had no boiler give way over wagon top.
9 report having straight boiler give way over fire-box.
20 report a preference for one dome with throttle in same over fire-box.
6 report a preference for two domes, placing the throttle in dome near smoke-stack.

In all cases where boilers give way in seams or otherwise over the fire-box of either straight or wagon-top boilers, they attribute the cause of same to faulty boiler-staying, more so than to poor materials. Some report poor workmanship as well as materials, while others give no cause. Nearly all report the iron ($\frac{7}{16}$) five-sixteenths thick where given out.

Those preferring the wagon-top boiler give their preference because they carry water better, have more steam room, and can get more heating surface than in the straight boiler.

Those preferring the straight boiler give their preference because they think them the stronger boiler.

The majority of those reported prefer the dome over the crown sheet on wagon-top boilers, claiming as an advantage that they get dryer steam, and carry the water better.

Those who report a preference for two domes advocate taking steam from both, as they will take steam more evenly and cause less rise in the water.

We hope to hear the experience of the Convention more fully on this subject, as out of the many roads so few have reported. All of which is respectfully submitted to the Association.

Very truly yours,
WM. H. GRIGGS, } *Committee.*
J. J. KINSEY, }

The Committee submitted with their report the following letter from Mr. H. A. Towne, of the Hannibal & St. Joseph Railroad:

LETTER OF MR. H. A. TOWNE.

HANNIBAL, Mo.

Messrs. Griggs and Kinsey, Committee on the Relative Merits of the Straight and Wagon-Top Locomotive Boilers:

GENTLEMEN: Replying to your questions on the above subject the writer will state that his experience would lead him to consider the wagon top decidedly the best. To reach anything near an elucidation of a subject involving so much detail, would require more time and attention than his official duties will at this time permit. He will, therefore, only refer to some facts and figures in connection with the subject. In the first place, we will consider the steaming qualities of a straight boiler compared with that of a wagon top. It will be admitted that evaporation is very materially increased or retarded in proportion to the amount of heating surface, and the flues being acknowledged the most effectual part of the heating surface of a locomotive boiler, the essential steaming qualities of the engine must therefore greatly depend on the number of these flues. The greatest number of 2-inch flues that can be got into a 47-inch straight boiler in vertical rows 9-16 of an inch apart at the back end is 142. This will give about 8 inches steam room above the flues in the highest place, allowing 8 inches of water on the crown sheet. A dry pipe, 5 inches or more in diameter, must now occupy a place in this space as near the top of the boiler as it can be placed, allowing room for its joint in the front flue sheet. We now have say 7 inches from top of boiler to under side of dry pipe. Going back now to the fire-box, we find 4 inches between the top of crown bars and dry pipe, or about 16 inches from top of crown sheet to top of boiler—ample room to raise the box sufficiently for one additional row of flues; but the box is already so wide that it cannot be raised without bringing the ends of the crown bars in contact with the shell of the boiler. Hence we have in this style of boiler the greatest number of flues, the greatest amount of water, and the greatest amount of steam room within its capacity. In other words, we have 142 2-inch flues 11 feet long, equal to about 809 superficial feet of heating surface; to this must be added about 113 superficial feet of heating surface contained in a fire-box of following dimensions, 35x60x60, including the Jauriet water arch, making all told 912 feet of heating surface and 59 cubic feet of steam room, including one dome 25 by 25 inches. If desired, the fire-box may be reduced three inches in width and carried up three inches higher, thus dispensing with one verti-

cal row of flues, five in number, and adding one horizontal row, eight in number, gaining three flues by the operation. At the same time there is yet room for the dry pipe above the crown bars, so that steam may still be taken from the back dome, thereby obviating the necessity of a front one, which, in the opinion of the writer, is superfluous, as he can see no advantage in two domes, unless steam is taken from them both. It will be seen that by raising the fire-box three inches, it will be necessary to carry that much more water, which will reduce the steam room about 19 cubic feet and only increase the heating surface about 17 superficial feet, clearly showing that what is gained in heating surface is more than lost in steam room by filling the boiler too full of water. So it appears that nothing can be gained by raising the box above the height named in the first instance (about sixteen inches below top of boiler). We will now take the same size of boiler, 47 inches in diameter, with 10 inches wagon-top, besides a back dome 25 by 25 inches, the same as in the case of the straight boiler; will also use same size of dry pipe (5 inches diameter), occupying the same place in the front sheet, about 7 inches from top of boiler to under side of pipe. If we now increase the height of the fire-box, so as to admit of two additional rows of flues, and make an offset in the dry pipe so that it will pass over the crown bars, as per tracing, we have the following figures: Fire-box 4 inches higher, or 35x60x64 inches, against 35x60x60 inches in the straight boiler, making an additional heating surface of several feet in the box alone, together with two additional rows of two-inch flues, 22 in number, or 164 all told, swelling the heating surface to 1,042 superficial feet, or 130 feet more than we have in the straight boiler. Having raised the fire-box 4 inches, we must necessarily carry that much more water, which reduces the steam room in the barrel of the boiler to about 4 inches in the highest place; but by the use of the ten-inch wagon-top we have 14 inches steam room over the fire-box instead of 8 inches, as in the case of the straight boiler. With this showing, we have in the wagon-top boiler 57½ cubic feet steam room, including one dome 25 by 25 inches, and 1,042 superficial feet of heating surface, against 912 feet of heating surface and 59 cubic feet of steam room in the straight boiler, or a gain in heating surface of about 11½ per cent. and a very trifling loss in steam room.

In a 12-inch wagon top we would swell the steam room to a little more than that in the straight boiler. It will be observed, then, that we have, by the use of the wagon top, 11½ per cent. more heating surface, nearly 7 per cent. more water and about the same amount of steam room. The heating surface of the wagon-top boiler may still be increased nearly 5 per cent. by swelling the sides of the fire-box so as to admit more flues, filling up the front sheet to the circle of the boiler, instead of leaving a useless water space between the flues and the sides of the boiler. The swelling of the box would prevent its being taken out in the usual manner, as it would not pass through the leg or outside shell of the box; but this would be considered no serious objection, as the back head can always be taken off for that purpose at a little extra expense, and frequently to a great advantage to the workmen, in the adjusting of manipulations for laying out the holes in the new box. There are other advantages in the wagon-top boilers which, though they may not be generally known, are well understood by competent locomotive runners. Those who have had practical experience with both boilers will, I think, testify to the superior merits of the latter, in the matter of carrying water without raising it while the engine is performing her hardest labor; also the better working of the engine, in consequence of using dryer steam, together with their invariably better steaming qualities, and consequently more economical use of fuel.

They carry their water better, because they have a larger body of hot water in which to neutralize the supply of cold water from the pumps, thereby causing less agitation, or priming. They use dryer steam, because the dome from which it is taken is much higher, hence the steam is less likely to become saturated by the surging of the water in the boiler caused by the galloping movement of the engine. After seven years' experience in running locomotives, I never run one with a straight boiler in which I could carry more than two gauges of water (or about three to five inches of water above the crown sheet), while working the engine up to her full capacity, without more or less priming. If at this time the engine should be foul and foaming, it would only be with the greatest care in regulating the supply from the pumps that the engineer would expect to find more than a flutter of water at the lower gauge, after shutting off. Even with a clean boiler, the suction caused by the steam passing into the dry pipe, together with the surging of the water, will raise a spray which will surcharge the steam to such an extent as to destroy much of the expansive force in the cylinders. In other words, much of the power of the engine will be lost by working water through the cylinders instead of dry steam. It will not be necessary to elaborate upon this subject to convince those familiar with the steam engine that dry steam is the essential, prime element of the engine; for steam surcharged with water will carry with it into the very heart of the engine that which will destroy its life, in the shape of a variety of all the impurities contained in the water, such as loose sediment, lime, grit, &c., which will subsequently cut the valves, piston and cylinders, besides causing the pounding of water between the piston and cylinder heads, rendering frequent repairs necessary to the entire engine. In this connection the writer would state that the use of a perforated dry pipe would, on this as well as many other accounts, be objectionable. While taking steam along the whole length of the pipe might have a tendency to raise the water less, yet it would not wholly destroy this effect; and the pipe being so much nearer the water than a throttle valve in the top of a dome, it would seem to upset the theory that the equalizing of the reception by the perforated pipe would prevent priming any more than a single opening in a pipe twenty inches higher. The perforated pipe would not do at all for a wagon-top boiler, because at high-water line the pipe would be half covered with water. In a straight boiler there would be about one inch between the under side of pipe and high-water line; hence, with three gauges of water, on an eighty foot grade, one end of the dry pipe would be under water, consequently both water and steam would be passing into the cylinders at the same time. It has been observed on some roads that dry pipes are more or less coated with scale, showing very clearly that they are at times entirely submerged, from the fact that incrustations will not form in the absence of water. The wagon-top possesses superior advantages over a straight boiler of same size, even with same amount of heating surface, because it will carry a larger body of water, and at the same time have a greater quantity of stored-up steam from which to supply the cylinders. The theory being, as a small boiler is to a large one, doing the same amount of work. The small boiler must be constantly crowded to its utmost, while the larger one will do its work with perfect ease, and with less water and fuel.

There are other considerations in favor of wagon-tops: they being located directly over the drivers, their additional weight, however little it may be, is just where it is needed for adhesion. It is the opinion of your correspondent that they might be carried up still higher to advantage, at the expense of the cylinder part of the boiler, thereby somewhat reducing the dead weight in front, and increasing the weight over the drivers. By reducing the cylinder part of the boiler to 40 inches diameter, with a fire-box the same height as the one in the 47-in. wagon-top boiler (64 inches), we would be able to get in the same number of flues that the 47-inch straight boiler now contains, and still have 8 inches or more space between the upper row of flues and top of the (40-inch) boiler. If we now carry up the wagon top 24 inches, on a radius of 25 inches, we will have nearly the same amount of steam room, an equal amount of heating surface, and nearly the same amount of water that we now get in the 47-inch straight boiler, at the same time increasing the weight on the drivers, and reducing the dead weight in front by as much as the difference in the weight of water, size of boiler, smoke arch, etc. Then, by reducing the weight of the truck, saddle and other things that will admit of it, in the same proportion, we would have a still greater percentage in favor of the wagon top. To the questions concerning the strength of a wagon-top compared with that of a straight boiler, I can only say that we have never heard of a wagon-top blowing off, or even giving way, under the pressure, so as to endanger its safety; on the contrary, whenever an explosion of this kind has taken place, the cylinder part of the boiler has, in every instance, given out first. The extra cost of a wagon-top over that of a straight boiler of the same size will not exceed the cost of two ordinary domes.

Respectfully,

H. A. TOWNE,
General Master Mechanic, Hannibal & St. Joseph Railroad.

The report was received and placed on file.

DISCUSSION ON STRAIGHT AND WAGON-TOP BOILERS.

Mr. ELLIOTT, Ohio & Mississippi Railroad—I think Mr. Towne, in making out his statement, has taken in view perhaps the very best construction of the wagon-top boiler and the worst of the straight boiler. His whole report seems to be based upon the idea that all are limited or confined to having the cylinder parts of the two boilers of the same size. When I build a straight boiler, I aim to build the cylinder part of the boiler larger, and I claim that I have a stronger boiler, with a larger cylinder, straight, than with a smaller cylinder with a wagon-top. For instance, take a 47-inch shell, and by increasing the diameter perhaps one inch I gain all the heating surface, by making room for more flues, that he gets from his wagon-top; and I have been looking to increase the heating surface in the fire-box by lengthening it as much as I have by adding to the number of flues. Then, again, as regards steam room, we gain steam room by giving more diameter to our boiler, by having a straight boiler and putting two domes on it. Mr. Towne claims that there is great advantage in having steam room, still he cannot see any advantage in having two domes. We certainly gain considerable steam room by having two domes in a boiler. However, I do not claim much for two domes; but I claim that a straight boiler, with one dome on the center of the cylinder part of the boiler, of a proper size, will carry water, to all intents and purposes, as well as a wagon-top boiler. But when you place a dome over the fire-box, then it is liable to all the objections that Mr. Towne brings against the boiler for carrying water; but when it is in the center, it then becomes a boiler that will carry water well. I have used that form of boiler very extensively, with one dome placed on the center, and never have found any inconvenience in carrying water, and I have never been able to see much advantage from having an additional dome. We have a number of engines running with two domes, taking steam away from the center; but I consider the back dome more an ornament than anything else, for it certainly does not carry water any better than a dome in the center. The dome should be a large one, and then it takes the place more of a wagon-top. If you reduce the dome in diameter, you will find that you carry water poorly. It is so small that it creates a current, which carries the water up with it. In my judgment, the strength of a straight boiler is very much greater than that of a wagon-top. Those boilers you spoke of, Mr. Setchell, were wagon-top boilers, were they not?

Mr. SETCHEL—The wagon tops were not stayed at all.

Mr. ELLIOTT—That only goes to show that they require so much additional strengthening, while the straight boiler is strong of itself, and requires none of this staying to stay these straight sheets. From your crown bars there is a place that is, perhaps, the most difficult part to strengthen in a boiler; in the straight boiler, we have nothing of that kind to contend with.

Mr. TOWNE, Hannibal & St. Joseph Railroad—In regard to the strength of the wagon-top boilers as compared with the straight ones, in theory, there may be considerable difference; but, as stated in the report, I never have had any trouble. I have never heard of a case where the wagon top has given out before the straight part of the boiler. In cases of explosions, the straight part of the boiler has invariably given out first. Mr. Setchel stated a moment ago that those wagon-tops were not stayed, which accounts for the fact of their giving way. If a wagon-top boiler is properly stayed, it will remain in position just precisely as well as a fire-box will hold together with your stays passing longitudinally. You must stay the box there, or you cannot hold it at all. So, in the same way, you must stay the wagon top of a boiler, or any other part of a boiler that is out of the regular circle. Our boilers are thoroughly stayed in the wagon top, and consequently we have no trouble with them whatever. We have never had them leak at all.

In reference to the size of the boiler, to which Mr. Elliott has referred, the two kinds of boiler are compared in the report. A 47-inch straight boiler, for instance, is compared in heating surface, steam room, and capacity for holding and carrying water, with the same size of wagon top. We get in a 47-inch wagon-top boiler 11½ per cent. more heating surface, about the same amount of steam room, and considerably more water is carried. I do not remember the exact per centage of increase. Consequently, we get a great deal better boiler, with the same size of shell. In other words, we get precisely as good a boiler with a 47-inch shell, with a 10-inch wagon-top, that we get in a 50-inch straight boiler, according to the drawings which have been gotten up, showing the capacity of the two boilers. Therefore I claim, that if you use the wagon-top boiler, you can dispense with the very large cylinder portion which it is necessary to use with a straight boiler alone. We find a great deal of difficulty with our present gauge, and probable shall find more with the narrow gauge which is advocated, in getting the boiler sufficiently large. A 48-inch boiler is as large as we can conveniently get into our present gauge, unless you carry it up high. Fifty-inch boilers are, I believe, the largest that are made. The larger we can get a boiler, the better, to be sure, but if we can get the same amount of heating surface in a wagon-top boiler of 47-inch diameter, that we can get in a 50-inch straight boiler, I do not see why a wagon-top boiler is not the better one, because it carries the weight back on the drivers, where we want it. If we could only still further reduce the length of our boilers, and put the weight on the drivers, all our engines would do better. Most of our engines are 33-ton engines, carrying from 10 to 13 tons on their trucks. By reducing the cylinder part of the boiler, we can reduce that weight very much, and carry it back on the drivers, and still maintain the same kind of engine, without throwing away any portion of those engines that are now in use. I have here drawings showing the difference between a wagon-top and straight boiler, with the same size cylinder. [Mr. T. explained the drawings, in considerable detail, showing that the statements he had made in regard to the relative merits of the two classes of boilers were supported by the facts.]

Mr. ELLIOTT, Ohio & Mississippi Railroad—I see the point which Mr. Towne wishes to make on the wagon-top in comparison with the straight boiler, and to my mind, there is just the same point of objection. I claim that there is great advantage in having the dome in the center of the boiler instead of having it right over the fire-box or crown-sheets, as is illustrated by the deposits made on the crown-sheets in the boiler. I think that, to a great extent, may be attributed to the fact of taking the steam right over the crown-sheet, which has a tendency to create a current and draw in the foreign substances floating over the crown-sheet, and these are deposited right on the crown-sheet, where it is a very difficult matter to remove them; whereas, in the other case, the tendency is to draw everything to the center and deposit it on the flues, where it is likely to reach the bottom of the boiler, where it can be easily removed. The question, however, is as to the matter of strength and steaming qualities between the wagon-top and straight boiler. I claim that I can go to work and make a straight boiler with all the steaming qualities that the wagon-top has; but it would not be the same boiler that Mr. Towne has drawn.

Another point. In my experience nearly every boiler that I have ever seen burst or explode, the rupture has been either on the sheet connecting the cylinder part with the wagon-top, or the wagon-top itself, extending through the cylinder part of the boiler, wearing perhaps into the front wing. Nearly all the boilers I have ever seen give out have given out in the neighborhood of the connection between the cylinder and wagon-top. I have seen four or five give out in that way; and that is the point I think we want to determine, as between the wagon-top and the straight boiler. I have known cases where men who have been building straight boilers have gone back to wagon-tops, and about the only reason they could give for it was that their engineers liked them better; and I believe that a great many master mechanics have gone back and now build wagon-top boilers contrary to their own judgment, because engineers, as a general thing, prefer the looks of and like the wagon-top boiler best, without having any good reason for it. If the straight boiler is the best, I claim that we ought to find it out and build that kind of boiler, in opposition to any fancy or taste of this kind. I would like to hear the experience of some who have tried the straight boilers.

Mr. JOHANN, Missouri Pacific Railroad—I will ask Mr. Towne whether he has had any of those straight boilers in operation, or whether he is merely illustrating from the drawings his ideas?

Mr. TOWNE—We have no straight boilers except for a few switching engines and construction engines. So far as the "fancy" of engineers is concerned, there is no fancy about it. I have run an engine with a straight boiler long enough to know just how that thing works, I believe.

Mr. JOHANN—I would simply state my experience in relation to this. We have had forty-six new engines, that were about equally divided between three builders: one lot with straight boilers and plain fire-box, with a single dome; another lot with wagon-top boilers, with a plain fire-box, with a single dome; the other lot had wagon-top boilers with about 8-inch combustion chambers. The number of flues in all the engines was the same, as near as I remember. We had considerable trouble with the wagon-top boilers of both classes, from their giving way in the gusset sheet, on the outside of the shell, and we have tried very many ways to overcome that difficulty. The boilers were made of American iron, and we were constantly patching them. The wagon-top boiler with the combustion chamber not only gives us trouble on the outside of gusset sheet, but inside, in the fire-box, where the distortion takes place for the combustion chamber. Not one of the straight boilers has given us any trouble, and in regard to their performance, a straight boiler with a single dome, and the same number of flues as the wagon-top, performed equally well as the others, making steam just as well, and hauling just as many cars.

That is my actual experience for four years, and I have finally come to the conclusion that the nearer we keep to straight lines the less trouble we will have with our boilers, and if I have anything more to say in regard to engines, my preference would be for straight boilers, with this exception as regards the dome. Although those have given us no trouble, and have done just as well as the wagon-top, yet we have had one or two cases, through the carelessness of the men, of overheating the crown-sheet. I believe that the dome should be on the cylinder part of the boiler, as near the center as possible, so as to get it on the axis of the boiler, so that when you are going on an up or down grade you will have the least disturbance at that point. That is the only difference that I would make.

With reference to having two domes, I do not think that it is absolutely necessary, but I would have a small dome over the fire-box, for the purpose of putting the safety valves there more easily. I would place my dome and take my steam from about the axis of the boiler.

Mr. SETCHEL—I only want to say one word in regard to the suggestion that I was building boilers without staying the wagon-tops. The boilers I spoke of were built by the manufacturers for the road before I took charge, and, as Mr. Elliott says, the point where they gave way was along the connection sheet between the cylinder part of the boiler and the wagon top, right along the seam.

Mr. HAYES, Illinois Central Railroad—Before you close the subject perhaps I had better say a word or two. I have written something upon that subject, which I would like to have read before the discussion closes, which will express my ideas better than I can do it on the floor. We have used both wagon-top and straight boilers, and I am free to admit that the straight boiler was a cheaper boiler to make and the stronger of the two; but out in the Western country, where the water is so bad, so impure, and there is so much lime deposit, we must have room to get into our boilers and clean the crown-sheets once every four months, or once in six months, certainly, and hence it is necessary for us to use wagon-top boilers, with a dome upon the wagon-top, in order to get in, to give us room. I would like to have our report upon that subject read, which will express my views much better than I can.

Mr. HUDSON, Rogers Locomotive Works—Speaking with regard to the opinion of engineers or runners of locomotives, I apprehend that many of us have acted in that capacity at some time or other. I have myself, as long ago as 1836, and occasionally for a good many years since, and my own experience with regard to wagon-top boilers and with regard to two domes is that they carry water better, and that there is less danger of their priming. They will stand a sudden opening of the throttle better than the straight boiler will.

While on that subject, I may say that the location of the throttle, and the way you take steam, has something to do with the comparative capacity of straight and wagon-top boilers for steam. In the one case, if you take the entire steam capacity of the steam pipe out of the boiler, and locate the throttle in the smoke-box, you have added that much more capacity to the boiler. In the other case, if you take the throttle dome out, you take the top, of course; and practically, I know that with the throttle located in the dome, with a straight boiler, you must be extremely careful how you handle it, otherwise you will take up water. While I agree in the opinion that it is better to locate the dome on the straight boiler somewhere forward, perhaps not exactly in the center of the boiler, but about in the center, where the steam comes with an even flow from last part of the boiler to that point, I am in favor of two domes, from the experience I have had, not as a locomotive builder, but as a practical railroad runner. I say I prefer two domes to one. Why? If we take steam only from the forward dome and locate the safety valves and throttle on the back dome, we divide the currents. When the engine has a surplus of steam, we all know that lifting the safety-valve very much beyond its ordinary height will carry out the water. I have known of cases where pretty much all the water was carried out of the boiler through the safety-valve by raising it higher than it ought to have been raised. Therefore, from that experience, I give my testimony in favor of the superiority of the wagon-top boiler and the two domes. I believe that the straight boiler, as ordinarily constructed, is the safest, but I believe also, at the same time, that

the wagon-top can be made equally safe; it is a matter of judgment as to how you will stay them. It is a question of practice as to how they are ordinarily stayed, but as they are ordinarily stayed I have but little doubt that the straight boiler is the strongest. At the same time, I have known cases of the sheet over the top of the straight boiler giving way; I have known also of cases of wagon-tops giving way. I do not think that proves anything, except that they gave way in their weakest part.

Mr. ROBINSON, Great Western Railway—I have heard nothing said here about European experience, and I would like to state the opinion that is expressed in such conventions as this held in England (the only institution that exists there is called the "Institution of Mechanical Engineers.") They say that in making boilers the plate should either be made circular or straight: by the word "circular," an ellipse is not meant. Now, the wagon-top boiler has an ellipse in it. It is circular in shape, and it comes down to a larger radius at the side, until it forms the straight part again, that was the wagon-top; it made the barrel circular, and the cylinder required no staying; therefore the back part was just as strong as the clyindrical part of the boiler. Nothwithstanding that, (mark the fact,) fifteen years ago, the subject came up when nearly all the railroads in Europe were using wagon-top boilers made in that way, and now they have given it up. I was over in Europe last spring, and made special enquiries in regard to this matter, and I don't think you will find 10 per cent. of the boilers used in Europe wagon-top boilers, because they insist upon circular or straight lines. The reason why they have given up the wagon-top in Europe especially, is this. They have tried both. On the line I was on we had about four hundred engines, and they were all this wagon-top kind; they call it the raised fire-box there; but at the present time, they have abandoned it entirely. When I was there they were commencing to build 200 engines with straight boilers. There is no prejudice on the part of locomotive runners in favor of the straight boiler; one boiler will run as well as the other, and give as good results in the consumption of fuel; and in regard to any prejudice which may exist, I think if there had been any I should have heard it where I was, as well as in other places. But of course the great thing they want to arrive at is, to get the strongest boiler consistent with the results and cost. I think the wagon-top has a very bad shape indeed. If you will have it, make it as they do in Europe, circular, and raise the centre and describe the whole circle from one radiating point. If you must have a wagon-top boiler, you will find that in order to stay the fire-box, they stay the boiler; therefore, the top shell and the fire-box are held rigidly together by stays. That is the strongest part of the boiler; the weakest part is from that point to where the stays begin on the other side. You never find any stays there. If you put steam into a bladder, it will press it out into a true circle; that is a natural law. The tendency of this boiler is to throw that out into a circle. It takes the nearest point, and, unfortunately, with us, that is the weakest point. The strongest pressure, therefore, in a locomotive boiler, the point where it is doing the most damage, is at this point, where it is not stayed, because it wants to go out and form a true circle; and in most boilers there are two niches that the steam is trying to press out and get into the true circle. If that is the weakest part, and if the boiler will burst, it will give way there; and the reason is, because there are so many angles and crooks, that the plate gets weaker in this seam than anywhere else. I contend that the straight boiler is by far preferable.

With regard to the position of the dome, I quite agree with the last speaker, that the position of the dome should be at that point where you can get the largest quantity of steam into it. I have a drawing here which gives my own idea as to what a good boiler should be. This dome is placed about one-third or a little more over the driving-wheels, because I want the weight there. I would not have the dome forward of the driving-wheels; if you put it there you get too much weight over the drivers. The right position for the steam is about one-third of the distance from this end, because most of the steam is raised over the fire-box, and the least steam at this end; therefore, in the one-third between the smoke-box and the dome there will be as much steam raised as in the other two-thirds, speaking roughly. We also, you perceive, put gusset stays at each end. Mr. Towne has mentioned the fact that it is necessary to get into the boiler to make repairs. Having longitudinal stays through the boiler, we find it very difficult to get into the boiler, unless we arrange it in this way. This is the English plan: gusset stays at each end of the boiler, so that a man can get down through this man-hole into the boiler, and there is about eighteen inches through which a man can easily crawl and do any work that is necessary. That has about 1,000 feet of heating surface, it is about 50 inches in diameter, has 148 tubes, and has a very fine space for the circulation of water on the sides. You see one great advantage of the straight-top boiler is that you increase the diameter of the boiler in order to get the right number of flues in, and you get very fine space on the side.

Mr. HAYES—You have said there are gussets at each end. Now, each of these tubes is a stay-bolt; the pressure of these is upon each head of the boiler and holding it. Now, if you put a gusset-stay here and here, does not that leave a weak point in the boiler here [referring to the drawing] liable to pull in two? Remember you have several tons pressure within those tubes, and several tons there. Does it not leave a weak place there?

Mr. ROBINSON—Does not the same thing apply to the longitudinal bolt?

Mr. HAYES—Run them clear through from the center; then you have no weak point.

Mr. ROBINSON—The longitudinal bolts will be just as rigid as the barrel of the boiler itself.

Mr. HAYES—The plan recommended was to run the stays from this to that head past the center; consequently you have no weak point. I have seen a boiler pull right in two by the longitudinal pressure on top of the boiler, because there were no stays there.

Mr. ROBINSON—All I can say is, that I have built boilers like these for about eight years, and seen them built, and I have never experienced any trouble in that respect. Of course it is one of those points on which, if there is any light to be gained by observation or experience, it is very desirable that we should have it.

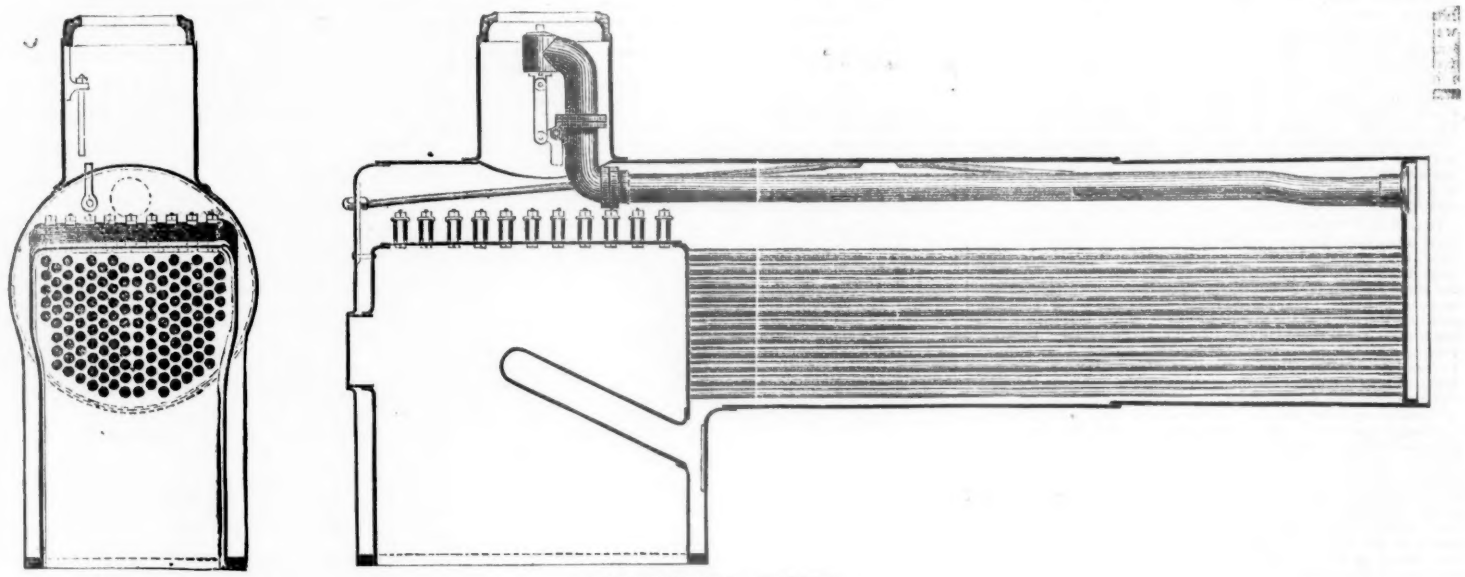
The PRESIDENT—When the report on "Boilers and Boiler Material" was up yesterday, there was one question and answer laid over until to-day when this report should come up. It will now be read:

"Your Committee recommend the wagon-top, in preference to the straight boiler, for locomotives, especially where impure water is used. It affords greater steam-room, larger water-surface over the furnace, and decreases the liability to foam where the water is bad. It is easy of access, when the mud and scale must be removed from the crown-sheet, or when repairs are necessary to the numerous braces over the furnace and, as stated by Mr. Wells, of the Jeffersonville, Madison & Indianapolis Railroad, it distributes the weight to greater advantage upon eight-wheeled engines with four drivers than does the straight boiler. The cylinder part can be smaller in diameter, and consequently lighter, than with the straight boiler, thereby lessening the weight upon the truck; while the furnace-end will have greater weight, due to the wagon-top, and will give proportionately more adhesion to the driving-wheels. The straight boiler can be built at less cost than the wagon-top, and is subject to fewer unequal strains; but your Committee think the advantages of the latter form more than compensates for the defects. Two domes are preferable to one on boilers with limited steam-space, and on boilers using impure water, providing steam is taken from both domes. Lesser variations in water-level and dryer steam in the cylinders are obtained.

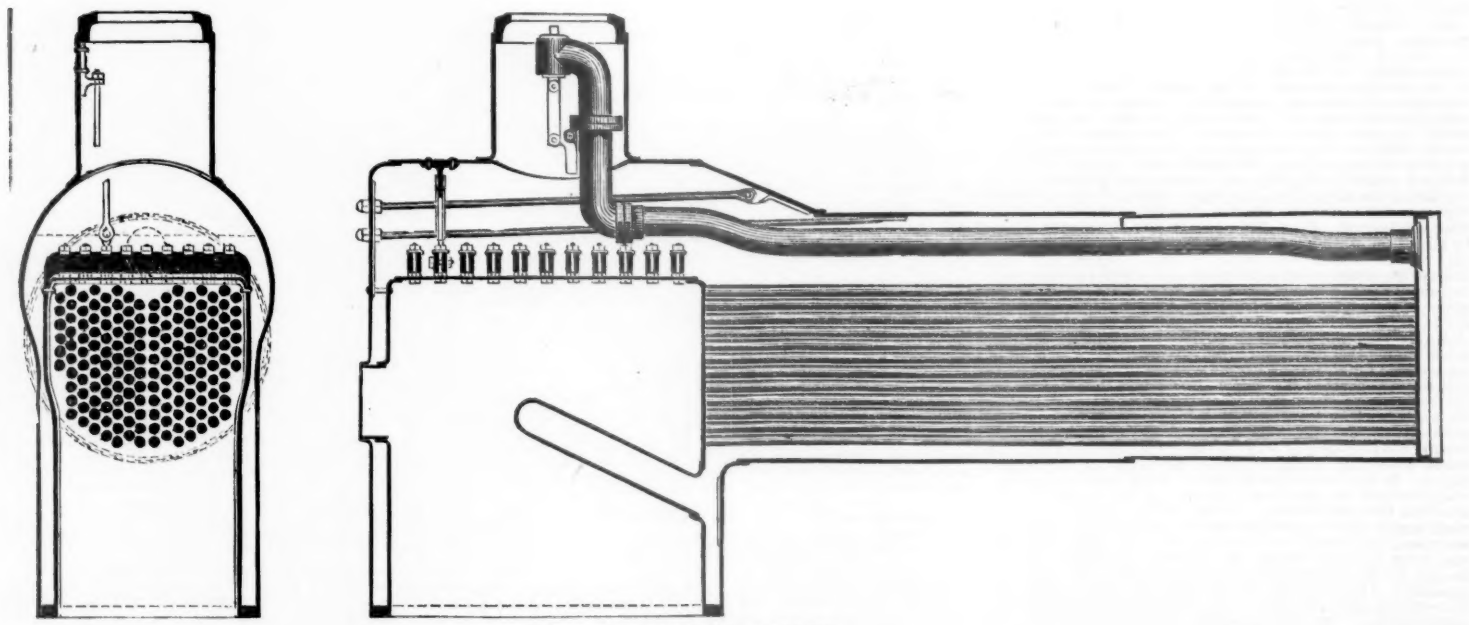
"Where the water is pure, or the boiler capacity large in proportion to power of engine, one dome is sufficient.

"Very few speak favorably of the perforated "dry-pipe" for locomotive boilers."

Mr. WELLS, Jeffersonville, Madison & Indianapolis Railroad—It seems to me, from the discussion that we have had here in regard to the different plans of boilers, that the only advantage that can be claimed for the wagon-top boiler is that of a better distribution of weight on the ordinary pattern of 8-wheel locomotive. As has been stated in the report of the Committee, the object there is that the boiler can be smaller at the front end, that is, the cylinder part of it, than the straight boiler, the total capacity of the two being the same; therefore, the back end of the wagon-top boiler would necessarily be heavier than the back end of the straight boiler, placing the weight where it would be of some advantage. I apprehend that there is no difficulty in the mind of any good mechanic in staying a wagon-top boiler sufficiently so that it would be practically just as good as the ordinary straight boiler. We all know that boilers frequently give trouble in what is called the connection sheets between the wagon-top and the cylinder part of the boiler, and we usually find the trouble on the side of the boiler, near the



STRAIGHT-TOP BOILER.



WAGON-TOP BOILER.

centre line; and in passing from a circle whose centre is in one point to a circle the center of which is six or eight inches above that, there must necessarily be a flat place in that connection. And as boilers are generally built, we know that that part of the boiler is not sufficiently stayed, and pressure coming upon it, has a tendency to throw it out and bring it in the form of a circle, throwing an unusual strain upon the bolts in the top of the fire-box, near the flue-sheets. For some years I have, in boilers of that kind, always placed one or two bars in that connection-sheet, placed them entirely in the boiler, immediately ahead of the flue-sheets, staying that part of the boiler the same as the crown-sheet and fire-box are stayed, running those stays down until they come some six or eight inches below the centre of the boiler, and extending them up to eight or ten inches above the centre line of the wagon top, and riveting them to the side sheets the same as the crown bar is riveted to the crown sheet. I have never had a boiler stayed in that way give any trouble whatever. They never leaked at these cross-seams, and I apprehend that if boilers were stayed in that way, there would never be any trouble with their giving out at that point. Also, immediately over the top row of tubes, from one to the other of those bars, I would place a connecting bar, running across the boiler, connecting two of those bars together, the connection being made by a fork and pin at each end. When boilers are constructed in that way, it seems to me they are certainly as safe as any ordinarily constructed straight boiler. This point could be just as easily stayed as the flat sides of a fire-box, if there is a proper disposition made of the braces.

Mr. SEDGLEY, Lake Shore & Michigan Southern Railway—Do you run them between the tubes?

Mr. WELLS—No, sir; these bars run vertically; they run down below the fourth row from the top, outside of the flue, between that and the shell. They are riveted between the shell and the tubes. They are not cross-stays. There is a cross-stay connecting two of those bars, above the top row of flues, as close down as we could get them, keeping the sides from spreading out, and at the same time those bars, running vertically, give that flat side stiffness.

Mr. YOUNG, Cleveland, Columbus, Cincinnati & Indianapolis Railroad—I would like to ask Mr. Wells whether the action of the iron, in expanding and contracting, would not be liable to heat at the ends of the bar?

Mr. WELLS—I have never had any difficulty of that kind.

The PRESIDENT—I will state, before this report is closed, that Mr. Philbrick, Maine Central Railroad, asked to be excused from serving on the Committee, and Mr. Griggs, New York & Oswego Midland Railroad, acted as Chairman.

Mr. PHILBRICK, Maine Central Railroad—Several gentlemen wish to have the question put, in the form of a vote, how many would prefer the wagon-top boilers and how many would prefer the straight boiler.

Mr. WELLS—Before that vote is taken I wish to make one statement. My preference for the wagon-top boiler is simply that there can be a better disposition of the weight on the ordinary pattern of 8-wheel locomotive; but when you come to the 10-wheel engine, or any engine where all the weight is carried on the driving-wheels, I prefer the straight-top boiler.

The PRESIDENT put the question—How many were in favor of the wagon-top, on that form of engine having four drivers and truck, and 28 gentlemen rose. Thirteen expressed their preference for the straight top.

OLD AND NEW ROADS.

Cincinnati & East Walnut City.

This street railroad, of three feet gauge, was opened for traffic June 30.

Indianapolis & St. Louis.

This company's new round-house at East St. Louis is 580 feet in circumference, and will accommodate twenty locomotives. It will be ready for use by the 1st of August.

Scioto Valley.

Ross County, Ohio, voted, July 8, to issue county bonds to the amount of $300,000 to this road.

Ohio & Kentucky.

The people of Ross County, Ohio, voted, on July 8, by a large majority, $300,000 in county bonds for the benefit of this road.

Painesville & Youngstown.

This narrow-gauge Ohio railroad was opened for traffic from Painesville to Chardon, 12 miles, July 4. The portion of the road from Warren to Youngstown will probably be next built, and it is hoped that at least 30 miles will be completed this year. The survey is now being continued through to the Ohio river. The rails from Painesville to Chardon were laid near the close of last year, but the road has only lately been put into condition for traffic.

Wilmington, Charlotte & Rutherford.

By an order of the Superior Court of New Hanover County, N. C., this road has formally passed into the hands of receivers. The receivers are Hon. H. G. Onderdonk, Dr. C. H. Roberts and Mr. Watson Matthews, of New York. The road has 125 miles in operation, from Wilmington to Forestville, N. C., and also another section of 43 miles from Charlotte to Cherryville, N. C. Some progress has been made in filling the gap between Forestville and Charlotte, 61¼ miles, and also in extending the road west from Cherryville to Shelby, 11 miles west. The management of the road continues as heretofore.

Cincinnati & Terre Haute.

This company will open the section of its road from Terre Haute southeast to Middleberry, Ind., about 30 miles, with an excursion August 6.

Natches & Brookhaven.

The Natches *Courier* says that Colonel McComb has agreed to furnish iron and rolling stock for this road, and that the road will be completed at an early day.

Cumberland & Ferrara.

The Commissioners of Morgan County, O., have issued their proclamation for an election to determine whether Morgan County shall issue its coupon bonds to the amount of $210,000 to build the following line of railroad: Beginning at Ferrara, in Perry County, thence through Perry and Morgan counties, by the most practicable route, to the town of Malta in Morgan County; thence to McConnellsville; thence through Morgan, Muskingum, Noble, and Guernsey counties to the town of Cumberland, with a branch line from McConnelsville down the Muskingum River to the Morgan and Washington County line, near Center Bend. The line will have a direction generally northwestward from Ferrara to Cumberland.

New Car Company.

The Higley Car Journal Company, of Cleveland, has filed the certificate of Corporation in the office of the Secretary of State, at Columbus, Ohio. The Company is organized for the manufacture of railroad and street cars, railroad car journal bearings, car brakes, car trucks, etc. The capital stock is $200,000, in shares of $100. The corporators are Aaron Higley, Christopher Sawyer, Thos. H. White, W. H. Truscott and G. I. Stanhope.

Iowa Pacific.

The Dubuque *Herald*, of recent date says: "Grading will commence along the line of this road in Franklin County this week. The grading between Belmond and Fort Dodge is completed; in Butler County, the work is about one-fourth done, and is progressing rapidly; a large portion of the grading is already completed in Bremer County. The company reckon on having the entire line graded and bridged from its junction with the Turkey Valley branch, at Fayette, to its terminal junction with the Maple Valley Road, by the 1st of October next. And it is not at all improbable that iron will be purchased and considerable track laid before the season closes."

Iowa Railroad Land Company.

This company (headquarters Cedar Rapids, Iowa), which has the management of the lands granted to the Iowa Divisions of the Chicago & Northwestern and Illinois Central roads, and to the Sioux City & Pacific road, reports as follows its land business for June, 1872:

Sales.

Iowa Railroad Land Co.	12,781.15	acres for	$85,748 27
Iowa Falls & Sioux City Railroad Co.	8,853 29	"	59,618 67
Sioux City & Pacific Railroad Co.	520.00	"	3,460 00
1 town lot	....	"	90 00
Blair Town Lot and Land Co.	10 00	"	50 00
30 town lots	....	"	4,935 00
Sioux City & I. F. T. L. and L. Co.	312.18	"	2 937 26
13 town lots	....	"	1,115 00
Total	22,476.62	"	$157,054 20

Number of land purchasers, 231.

Cash Collections.

Iowa Railroad Land Co.	$38,095 67
Iowa Falls & Sioux City Railroad Co.	24,903 48
Sioux City & Pacific Railroad Co.	1,370 12
Blair Town Lot and Land Co	3,647 79
Sioux City & Iowa Falls Town Lot and Land Co.	9,626 83
Total	$77,643 89

The sales were thus on an average a little less than 100 acres each, and the average rate just about $7 per acre. Most of the purchasers were farmers from Illinois, Wisconsin and Eastern Iowa.

Columbus & Toledo.

The people of Toledo, July 1, voted to subscribe $200,000 to this road. This action is said to secure the construction of the road.

Northern Pacific.

Olympia, Wash. Ter., papers report that it is rumored that the Secretary of the Interior has notified the company, that, as soon as they complete their railroad to the waters of the Sound at any point, it will be regarded as the terminus, and the land grant will cease. In consequence of this the company will build to Bellingham Bay before approaching the waters of the Sound, and build branch roads afterward to Olympia, Seattle and other points. The surveying party under Captain Sheets has run 40 miles from the Sound on level ground only rising 140 feet from the sea in that distance. There seems to be an easy grade to the Skagit Pass, and it is most likely this route will be selected for the railroad.

California Pacific.

The railroad company are now repairing the break between Sacramento and Davisville. Five pile drivers are at work on the break.

Central Pacific.

The Sonoma, Cal., *Democrat* says: "We learn, from good authority, that the Central Pacific Railroad Company will at an early day commence the construction of a road, commencing at a point a few miles west of Bridgeport, on the California Pacific road, thence to Suscol, thence skirting the shore of the bay to Petaluma Creek, and from there to Saucelito Such a road would improve the facilities for travel of the whole tier of counties north of Napa and Sonoma and west of Solano, and do away with the present steamboat connection."

Rochester & State Line.

This company advertises for proposals for the grading and masonry of its road from Rochester southwest to Salamanca, N. Y., about 100 miles, to be handed in to the office in Rochester by the 25th of July. Profiles, specifications, and estimates can be seen at the office. C. S. Martin is Chief Engineer and D. McNaughton, Secretary. This road will give the Atlantic & Great Western a direct and short connection with the New York Central, which may be valuable, especially for New England business.

Pennsylvania Railroad.

This company has commenced running a through express from New York to Cape May, by way of Trenton, Camden and the West Jersey Railroad. This train leaves New York at 12.30 p. m., reaching Cape May at 6.37 p. m., and, returning, leaves Cape May at 7.30 a. m., reaching New York at 2.14 p. m. Excursion tickets are sold for $8.00 for the trip.

Philadelphia & Attleboro.

A survey is now being made for a narrow-gauge railroad from Philadelphia to Attleboro, in Bucks County, about 17 miles. The Philadelphia *Press* says the road will start from the intersection of the Reading, Frankford and Southwark railroads and pass through Frankford, Bustleton, Somerton and Brownsville.

New York & Harlem.

Proposals for the work known as the "Fourth avenue improvement," including an immense amount of rock and other cutting, a large number of bridges and a great deal of masonry, will be received by the Board of Engineers at the Grand Central Depot until 2 p. m., July 20.

Great Western of Canada.

This company now invites proposals for the construction and delivery at any point on its road by the 15th of November of 30 double-deck cars and 70 merchandise box cars of patterns which may be seen on application to the Mechanical Superintendent, Mr. Robinson, at Hamilton, Ont., of whom, also, particulars may be had. The tenders are to be handed into the Treasurer, Joseph Price, at Hamilton, by July 31.

The company also invites tenders for the purchase of about 600 tons of old T rails, 65 lbs. per yard, to be delivered either at Suspension Bridge, Windsor or Sarnia within three months after awarding the contract. Proposals for these must be received by the Treasurer by July 24.

New York, West Shore & Chicago.

The Buffalo *Commercial Advertiser* says: "It is announced that the officers of this road have executed to the Farmers' Loan & Trust Company, of New York, a mortgage on the whole line from New York to Buffalo, to secure the payment of the first-mortgage bonds of the company to be issued to the amount of $35,000 per mile, and to be appropriated for the construction and equipment of the road. The mortgage has been recorded in this county and all other counties through which the road passes. The line, as described in the mortgage, runs up the west shore of the Hudson River to Catskill, thence to the Mohawk Valley at Schenectady, and thence along the south side of the Mohawk to Utica, thence to Syracuse, Rochester and Buffalo."

Vicksburg, Shreveport & Texas.

A letter from Mr. J. L. Garrison, of Marshall, Texas, published in the St. Louis *Republican*, says:

"In the course of twelve months I think we will have some direct rail connection with St. Louis, and we have a fine prospect of a connection from here. Mr. Thomas A. Scott proposes that if the sum of $500,000 be subscribed in stock, he will buy the old Vicksburg, Shreveport & Texas road, and in twelve months complete the gap between Shreveport and Monroe, thereby giving us uninterrupted rail connection with the east and west. He exacted of the citizens of this town and county $300,000 and sixty-six acres of land, and pledged himself to build a road from here to Jefferson, making a connection there with the Trans-Continental, of which he is the controlling spirit, and which road he proposes to put through to Fulton, and on north as fast as possible."

Athol & Enfield.

The Springfield *Republican* says:

"The grading on seven of the eight sections of the Athol & Enfield Railroad from Barrett's station to this city has been let as follows: Section 1, beginning at Barrett's, to J. M. Stone, of Ashburnham; 3, to Shephard & Barney, of Southbridge; 4, to Dow & Co., of this city; 5 and 6, to George Hendrick, of Easthampton; 7 and 8, to King & Walker, of this city. Section 8 is the deep cut in this city, where the road is to pass through the farm of Col. Thompson. Excavations of 100,000 yards will be made on this section, and a steam shovel will soon be put to work. The average price of the grading is about 27 cents per cubic yard. Work will be begun at once. Geo. A. Ellis, acting Superintendent of the Athol & Enfield Railroad, will have charge (as engineer) of the extension."

Lee & Hudson.

Ground was broken July 9 for the Lee & Hudson Railroad, in West Stockbridge, Mass., half a mile east of that village. A gang of ten men began operations, which number will soon be increased to one hundred. Mr. Barker and Mr. Merchant, of South Adams, are completing the remainder of the way from Glendale to Lee. At "Farey's quarry" the road passes through a cut in the rock. There is a curve at this point, and the grade for the road-bed is 160 feet above the Housatonic track. Most of the road will be easy to construct.

Portland & Ogdensburg.

On the second trial, July 9, Portland voted, 2,9 39 to 961, to take stock in the Portland & Ogdensburg Railroad Company.

Laclede & Fort Scott.

The contract for constructing this road was let about a year ago to a corporation known as "The Laclede Contractors," in which Messrs. Fitch, Colehour and Orville Grant (the latter a brother of President Grant) were prominent. Since that time not much has been said of the road. It seems, however, that a controversy has arisen as to who shall control the railroad company. A meeting of the citizens of Laclede County was held in Lebanon, Mo., July 8, at which it was charged that an illegal meeting of the Laclede & Fort Scott Railroad Company was held in St. Louis, June 17, at which a board of directors was chosen, and that the President had turned over the books and other property of the company to this illegal board. This meeting passed resolutions declaring the election at that time fraudulent and illegal, appointing a committee to take steps to recover the books and papers of the company, and asking for the co-operation of the other counties between Lebanon and Fort Scott in this action, and calling a meeting of stockholders to be held at Bolivar, Mo., July 17, to elect a new board.

One of the judges of the County Court of Laclede was present and said that he would never consent to the issuing of the $65,000 of bonds voted to the company by the county, unless the road should be completed to Buffalo, Mo., by the beginning of next year.

Milwaukee & St. Paul.

This company has offered to extend its track from the present depot in La Crosse to a point between the La Crosse River and Vine street, and to build a new depot there provided the city will give the right of way and depot-grounds. It will begin work as soon as the proposition is accepted.

[CONTINUED ON PAGE 311.]

RAILROAD GAZETTE

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A. N. KELLOGG & CO., *Proprietors.*

S. WRIGHT DUNNING AND M. N. FORNEY, *Editors.*

W. H. BOARDMAN, *Acting Publisher.*

CONTENTS.

Editorial Announcements.

Address.—The RAILROAD GAZETTE *will be printed for the present in New York; our printing house in Chicago having been destroyed. All communications, therefore, whether editorial or business, should be directed to the New York office. The proprietor will receive subscriptions and advertisements at his office in Chicago, Nos. 63 and 65 South Canal street, but letters should be addressed to New York.*

Correspondence.—We cordially invite the co-operation of the railroad public in affording us the material for a thorough and worthy railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Inventions.—No charge is made for publishing descriptions of what we consider important and interesting improvements in railroad machinery, rolling stock, etc.; but when engravings are necessary the inventor must supply them.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

LOCOMOTIVE BOILERS.

On another page will be found the report of the Master Mechanics' Association Committee, and also a very able paper on "The Relative Merits of Straight and Wagon-top Locomotive Boilers," the latter by Mr. H. A. Towne, of the Hannibal & St. Joseph Railroad. In the Report on Boilers and Boiler Material, the relative merits of one and two domes were also discussed. As very nearly the same considerations will determine whether wagon-top or straight boilers are best, and whether one or two domes are preferable, we propose to discuss the question in connection, and then offer some general considerations on the subject of locomotive boilers.

In the outset we will say that in criticising the discussion of this subject, we purpose not so much to question the *conclusions* of the committees and authors of the reports and papers and of the Association itself, as the reasoning by which their conclusions are sustained. It will be observed that in all the discussion no comparisons are made of the *weights* of the two kinds of boilers. Now, obviously, if the size of boilers is limited by the weight which it is admissable to place on the wheels, and if a wagon-top will weigh more than a straight boiler of the same diameter, then the latter may be made larger and be of the same weight as the other. It is not, as much of the discussion seems to assume, which form will be best for a given *diameter* of boiler, but which will be best for a given *weight*. It was admitted by all that wagon-top boilers require more and stronger staying and bracing, and what is technically called the "wagon top" itself adds materially to the weight. If, therefore, Mr. Towne had estimated the weight of each form as represented by the drawings which he submitted, and which we have had engraved, he would have contributed information which is very essential to a proper solution or determination of this question.

The location of the domes, too, is an element which must be taken into consideration. If there is but one, and it is located over the fire-box, where the ebullition is most violent, there must necessarily be more steam-room, to prevent the water being carried into the steam-pipe, than would be required if the dome were over the tubes. The variation of water-level due to the inclination of the track and the surging of the water will be greatest at the ends of the boiler and least in the center. On merely theoretical grounds, therefore, it seems probable that the steam taken from a dome located in the center of the boiler would be dryer than if taken from a point over the fire-box, and this would seem to indicate that the evils complained of in straight-top boilers are to a very great extent due to the fact of taking steam from a dome over the fire-box instead of the center of the boiler. Now if we keep carefully in mind the importance of comparing the weights instead of the dimension of boilers, and then remember that one with a straight top of a larger diameter will weigh no more than a wagon-top boiler of a smaller size, we will see that with the dome located in the centre, the straight-top boiler has an advantage over the other. The question thus becomes, Whether steam taken from a dome located in the center of a boiler of larger diameter will be dryer then if taken from one over the fire-box of a boiler of smaller diameter with a wagon-top. The advantage claimed for wagon-top boilers of greater steam room and water capacity is gained equally well by the enlargement of the diameter of the straight boiler. The distribution of weight on the driving wheels, it must be admitted, with the present arrangement of boiler and engine, is in favor of the wagon-top, and locating the dome in the center increases the disadvantage in this respect of the straight boiler. It is also claimed that the wagon-top gives more room, and, consequently, makes the crown-bars, crown-sheet and braces more easy of access when they need repair or cleansing. The former advantage, we believe, could be more fully realized by a different arrangement of boiler, of which we will speak at some future time, and the latter by a different construction of crown-sheet and braces. In this connection it might not be unwise to observe that in European practice wagon-top boilers are now almost unknown, and domes, or their equivalent, almost always located on the centers of the boilers.

In considering the subject of locomotive boiler construction, we should never forget what is now, we believe, generally admitted, that the larger the boiler, the more economically will it consume its fuel. For this there seem to be two reasons: first, the combustion is slower, and consequently more perfect, and the flames and smoke are thus in contact with the heated surface a longer time, and therefore impart more of their heat to the water; second, the water capacity of a large boiler being greater than a small one, there is more hot water stored up for use when the maximum power of the engine must be exercised, and therefore the fire need not be forced so much as it would be if it were necessary to generate all the steam consumed at such times as fast as it is used. The committee who have this subject under consideration for the next year would, we think, therefore do well to direct their inquiries so as to determine how the largest locomotive boiler can be made of a given weight, and of the requisite strength.

THE MICHIGAN CENTRAL REPORT.

It is not often that we have a railroad report so interesting to railroad men generally as that of the Michigan Central for the year which closed with the month of May last. President Joy has reported frankly what was unfavorable as well as what was favorable in the working of the road during the year, and given a historical sketch of the traffic of the line, and entered into a discussion of the causes which have prevented its doing as much and as good work as it should have done last year, of the means necessary to qualify it to do its work, and of the changing circumstances influencing it and most other Western railroads, which tend to affect its traffic in some degree and its receipts still more.

The Michigan Central was almost the first of Western railroads to make a reputation as a carrier careful to give its patrons the best accommodations, and conscientious in carrying out its contracts. It was elegantly equipped many years ago, and the speed of its express trains was excelled only on the Hudson River Railroad, at a time when some of its competitors were either incomplete or else shabbily equipped and indifferently managed. It was especially a favorite passenger route, and in those days it made hosts of friends who have never forgotten it. It is fairly well placed. For through traffic it is a little shorter than its competitor on the south, and the country on the line is well peopled, well cultivated, and has a good number of large towns. Still its situation is not such as to attract the traffic of considerable tributary lines of railroad east of its Western terminus. On the north the Great Lakes limit its territory, and nearly one-half of the peninsula is almost uninhabited. Long lines cannot reach it from the south without first crossing the Lake Shore & Michigan Southern road, which will serve them as well for a connection to the East, and save the construction of twenty or thirty miles of line. However, for a long time traffic was abundant and there was scarcely any competition for the fine local business. The State of Michigan had few railroads and those north of the Central were likely to find it their most convenient outlet. Meanwhile a vast system was growing west of Chicago, and the Michigan Central received its full share of their traffic. But at the same time the competing lines were being put into better and better condition, until they ranked with the first in the country in speed and accommodations for passengers and promptness and certainty for freight. Thus while the Michigan Central in nothing went backward, the difference between it and its rivals decreased or disappeared by their going forward. Then, again, the first link in the Central's connection with the East, the Great Western of Canada, came to be in shocking condition, so that it was the rule rather than the exception for its trains to miss connections. This continued for a few years, during which the fact that the Central's through traffic was kept up tolerably was probably very largely due to the excellent reputation it had made in former years. A few years ago, however, there was a revolution in the Great Western, and for much of the time since it has been better rather than worse than the Michigan Central.

But about the time the Great Western began to mend, or a little before, a new danger threatened. Michigan, which for years had made very little progress in railroad construction, seemed to grow wild on the subject, and the State was full of projects for new lines, local aid was freely granted, and it became certain that a great many new railroads would be constructed. Very many of these were in the district from which the Michigan Central had obtained its traffic—most of them north of its line—and it was evident that if these lines should be opposed or discouraged, or even neglected, they would be very likely to carry their traffic to the Michigan Southern, or even to the Fort Wayne road, and thus take away from the Central a large share of its business and leave little opportunity for a future increase. Under these circumstances, the company secured in its interest a very large proportion of these roads, including some, doubtless, which it would have preferred not to have built—at least so early. That is, the country insisting on building the roads, the company preferred that they should bring traffic to it rather than from it. The roads so secured, some of which have no nominal connection with the company, but are controlled by its managers, include no less than five lines north of the Michigan Central, with about 700 miles of road (only 283 of which it operates), and three lines, with 232 miles of road, south of that road, 113 of which it operates, with perhaps some influence in the management of a fourth, of 100 miles.

Now this rapid and sudden growth of connecting roads, still greater west than east of Chicago, has given a traffic which has proved too much for the capacity of the road and equipment, and last winter it failed to do all the business that was offered it, and yet was so crowded as not to be able to do its work well or economically. There were peculiar circumstances which aggravated the pressure of the traffic, yet the fact remains that the road was unequal to its business.

That its being thus caught unprepared was not inexcusable, is very well shown by Mr. Joy in his history of the traffic of the line. For the ten years preceding 1868 the increase in traffic had not been sufficient to necessitate any other increase in motive power than that given by replacing light locomotives, as they wore out, with heavier ones. There were 98 locomotives in 1858, and there were only 98 in 1868. The tonnage of freight moved was only one-eighth more in 1868 than in 1863, and the tonnage of the first was above the average of the five following years. 1869 showed an increase of about 25 per cent., but the following year the increase was only 3 per cent., and both road and equipment were sufficient. Meanwhile the passenger traffic remained almost stationary. It is therefore not wonderful that inadequate preparations were made for an increase of more than one-third in 1871, and a further increase of 12 per cent. in 1872.

It is not often that a company has an opportunity to complain of an excess of traffic offered. But in this case it is altogether probable that the company would have made greater profits if it had had less business at certain times of the year. The blocking of the road not only caused a decrease of its capacity for considerable periods, but an increase in its working expenses. These, exclusive of taxes, have risen from 56 per cent. in the last year of the war to 69½ in 1871, and 68¾ in 1872.

But the report shows that the work of removing all disabilities is not only determined upon but already far advanced. By another winter most of the line will have a double track and a large part will have steel rails. The equipment will be largely increased, the Eastern connections increased in capacity, and the completion of the Detroit Tunnel, already begun, will be the only thing necessary to put the line in the best condition for the

economical conduct of an immense traffic with as much dispatch, safety and certainty as is practicable on modern railroads anywhere.

THE KANSAS PACIFIC.

The Kansas Pacific Railway report for 1871 gives for the first time the result of the operations of the road since its extension to Denver. The average length operated was 673 miles in 1871 against 551 miles in 1870, the increase in mileage being equal to 22 per cent. The receipts were $3,312,517.83 in 1871 and $3,360,786.61 in 1870—there being the small decrease of $48,268.78, or about 1½ per cent. The directors call attention to the fact that $385,965.80 of the earnings of 1871 were from the carriage of materials for the extension to Denver, so that the decrease is less than it appears to be. The receipts per mile show the rate of receipts more accurately. These are $6,099.43 in 1870 and $4,922.02 in 1871, the decrease being $1,175 per mile or 19½ per cent. This is a pretty large falling-off for a new road, in a new country which should be (and is) growing rapidly; but, aside from the lack of traffic in materials for construction, there have been circumstances which account for this. One of these is a decrease in the rate of immigration (which was extraordinary the previous year), and the carriage of immigrants and their goods has given this and the other Kansas railroads a large share of their traffic. In the next place there has been some increase in the railroads, and a considerable decrease in rates consequent upon the completion of the new lines, the railroads in Kansas, as in most of the northwestern States, having increased of late much faster than the traffic.

It was not to be expected that the earnings should increase in proportion to the mileage, for the extension to Denver is through a country in large part a wilderness. It gives, however, access to Colorado and a connection with the Union Pacific. The former has been valuable, and the Kansas Pacific probably has the largest part of the Colorado traffic, which is considerable. The latter is not worth much as yet, as the Union Pacific make such rates as to prohibit traffic by way of the Kansas Pacific from the Pacific cost, except at rates which are not merely unremunerative, but positively ruinous.

The statistics of the movement of freight and passengers shows that in freight the bulk of the traffic has remained almost the same, the tons hauled one mile being 49,052,188 in 1870, and 50,670,965 in 1871. It is noticeable that about two-thirds of the tonnage was moved westward, which is the reverse of the prevalent current of the country and of the West especially, and indicates that the territory through which the road runs has not yet fairly begun to produce for export. There is this of encouragement in it, however, and that is that much of the westward traffic is in the nature of seed for future traffic, and will return with increase shortly.

The movement in passengers shows a considerable increase in mileage (14,708,284 to 19,727,390) but very little in number (198,871 to 201,592); the average distance travelled has increased since the opening to December from 74.25 to 97.85 miles.

The most encouraging feature in the history of the operations for the year is the considerable decrease in the working expenses, notwithstanding the increased mileage worked and the large increase of train mileage (more than one third). This decrease amounted to $177,450.50 and the percentage of expenses to earnings was 69.51 in 1871 against 73.79 in 1870. Thus, in spite of the decrease in gross receipts the net earnings are greater by $129,000, or nearly 15 per cent., and with a decrease of $1,175 per mile in receipts the net earnings have fallen off but $100 per mile—from $1,599.58 in 1870 to $1,500.64 in 1871.

This difference is shown more emphatically by a statement which the directors make for the two halves of 1871. The first half-year showed receipts $1,430,292.89 and expenses $1,264,932.98, or 88½ per cent.—fairly promising bankruptcy; while the second half-year, the earnings being $1,882,224.94, the expenses were $1,037,656.99, or 55 per cent.

In spite of the competition from new Kansas roads, some of which reached the border of the Indian Territory, the road maintained its command of the Texas cattle traffic, the shipments having increased by one-sixth over those of the previous year; the competition was more successful in reducing rates than in drawing away the business. With the advance of settlements westward, the shipments of cattle are made further west, the trails from the Indian Territory being made where they will have the freest range and the fewest obstacles, in the way of cultivated and fenced grounds, villages, etc. Another railroad has entered the field recently, and the Missouri, Kansas & Texas will soon invite shipments in Texas itself, so that it is reasonable to suppose that the Kansas Pacific will not maintain its old proportion of their shipments, as the other lines will all get some of them. This year, we believe the number to be shipped is unusually small.

The land grant of this company is one of its important assets, and the income from this source is just now almost indispensable to it. There were 121,743 acres sold during the year at an average price of $3.56 per acre. What is particularly encouraging is the establishment of considerable settlements in Western Kansas, which has been looked upon as uninhabitable, or at least undesirable and unlikely to be settled so long as more attractive land is abundant in the United States. The company's Industrial Agent has done much to investigate and make known the hidden capabilities of these barren plains by judicious experiments with grains, grasses and tree planting. Many trees started and grew well this first year without irrigation, and it seems quite probable that if plantations of forests can once be grown, they will essentially and permanently modify the climate, and make inhabitable, productive, valuable and salable a vast area of land belonging to the company which otherwise will scarcely find a customer. If profitable production on these plains can be made feasible, the future of the road is assured. Its course is in the direction of traffic, and it is better situated than any other Kansas road to become a trunk line for a system of branches. It can be used advahtageously as a section of a route from the country on its line and west of it to the Lakes as well as to St. Louis and the East, and also to the South.

The company is now encouraging the construction of branches. One from Kit Carson, near the Colorado border, southwest to the Arkansas at Fort Lyon, 54 miles, it is proposed to build this season. This will enable the company to present better facilities for the New Mexico traffic. Another is proposed from Junction City northwest to Fort Kearney, along the Republican valley. Most of Kansas can secure railroad outlets more readily and at less expense by making roads to a junction to the Kansas Pacific than in any other way; and it would seem to be the policy of an enlightened administration to secure such feeders, when it can be done without involving the company unduly.

The result of operations for the present year, so far as reported, show a decided improvement, the increase for the half year ending with June having been $222,500, or nearly 16 per cent. If this rate of increase is maintained, and the expenses are kept down to something like the rate for the last half of 1871—say to 60 per cent.—the result will be very satisfactory, as it would produce half a million dollars, or 50 per cent., more net earnings than in 1871. It may not, however, be possible to maintain so low a rate of working expenses, as the road is now getting old enough to need some renewals.

Supplement.

With this number we issue four supplemental pages to provide the space which the report of the Master Mechanics' Convention and the Narrow-Gauge Convention Committee require. We hope to be able to complete the official report of the Master Mechanics' Convention in two or at most three more numbers. We call especial attention to the discussions as well as the papers in this report, as being of unusual value to all interested in railroad rolling stock and especially in locomotive construction.

The Erie Railway.

The Erie Railway Company announced in the London journals of June 29 a new issue of $30,000,000 or £6,000,000 7 per cent. consolidated mortgage bonds, being the loan authorized by the directors as long ago as September, 1870, and executed at that date, the trustees being the Farmers' Loan and Trust Company. The announcement sets forth that cash subscriptions will be received for $6,446,000, the balance being set apart for the conversion of the previously existing mortgage debts, which bear the same interest, and consists of first, second, third, fourth and fifth mortgage bonds, and the bonds of the Buffalo Branch, and $5,000,000 of sterling bonds payable in London. In offering the new bonds the agents, Messrs. Bischoffscheim & Goldschmidt, say: "Arrangements are in progress for providing additional rolling stock to meet the requirements of the increasing business of the line, and the efforts of the present board are being energetically directed toward the cultivation of friendly relations with neighboring companies for interchange of traffic. By such mutual accommodation of interests, it may reasonably be expected that many very large and available sources of revenue hitherto neglected will be opened up, and the earnings of the company correspondingly augmented."

What is said here about "friendly relations with neighboring companies for the interchange of traffic" may be interpreted to mean a combination with the Atlantic & Great Western. But viewing it in the light of the late election, more than this, we think, may be inferred. For no cultivation of friendly relations is necessary to secure an interchange of traffic with this road. Its traffic went to the Erie no less after the dissolution of the late lease than before, and it goes to it still, simply because from its location it can go nowhere else. Not only is there no other road over which its broad-gauge cars can run, but it connects with no other road to the East at its terminus. By giving up 61 miles of the eastern part of its line (Corry to Salamanca) it could have a connection by way of Harrisburg and Philadelphia which would be 25 miles longer and with heavier grades. If it would reach to the New York Central it must also turn its traffic at Corry, and use the Buffalo, Corry & Pittsburgh and the Lake Shore roads, and the distance to New York will be 532 miles, against 500 by the Philadelphia & Erie, and 473 by the Erie.

But in the new directory are several gentlemen prominent in other railroad companies. Mr. John Taylor Johnston, President, of the Central of New Jersey, is at the head of a corporation or combination of corporations which has a system of lines north as well as south of the Erie; and though they are not likely to give it any traffic for New York, they may, with advantage to themselves and it, give it a very large coal traffic for transportation westward—in which direction the Erie's freight cars for the most part go empty. So Mr. Olyphant, of the Delaware & Hudson Canal Company, has control of an immense coal traffic, and also of the Albany & Susquehanna Railroad, which latter can be used to give the Erie a line from Buffalo to Albany, by which it may compete for Boston and other New England freight to and from the West. It is 350 miles long—53 miles longer than the New York Central—but that would not prevent its doing a share of the business, especially as the line has a uniform gauge, and cars can be run through. Mr. Watson, the President himself, though having no control of any considerable line (probably of none, the roads in which he is interested being leased to the Lake Shore & Michigan Southern), yet seems to have, to an unusual degree, the ability to combine what have been usually conflicting and irreconcilable interests, if we can put faith in the stories told of his success in securing the cooperation of all the companies—Erie, Central and Pennsylvania—in the plans of the South Improvement Company, of which he was President. It is of course impossible to tell precisely how far the railroad companies were committed to this scheme; but it is certain enough that the success of the company depended on their combination, and that the popular belief in their combination was sufficient to cause a storm of indignation such as never was before exhibited against any commercial company in this country—a storm which absolutely swept away the company within a few weeks, it having been literally hated to death before it had fairly commenced operations. Now this scheme may not have been very creditable to Mr. Watson, but its history may lead one to think that he, more than one identified with any of the three great corporations, may be able to unite them in a common policy: perhaps simply an agreement as to rates such as will not be broken; perhaps even a "pooling" of receipts and a division in some definite proportions—a scheme which, it is believed, came near being adopted a few years ago. This latter, however, would not be so easy now, when the other companies have secured thousands of miles of Western connections, and the Erie is almost alone, unless indeed the Erie Company should be very moderate in its demands. What appears more feasible is an agreement to maintain rates on west-bound freights, which for nearly half of the time during the last two or three years have procured no profits. Not that agreements have not been made often enough, but they have not been kept, and the general complaint has been that the Erie was always ready to violate such agreements whenever it thought best. It might be thought that it would gain as much as any by maintaining rates, but it probably would do better if it were permitted to carry a little cheaper than the other lines. The necessity of transhipment is a disadvantage which shippers naturally take into account, and the company cannot easily get shipments from points off its line unless it makes a reduction of rates to offset this disadvantage. A reduction once begun, rates may "break" and fall to any ridiculously low figure. But the Erie, more than other lines, is tempted to make the reductions, because in its present condition it is not easy to get through freights from connecting roads without them.

How Much Are You Worth? is a question which a jury may have to consider in a sense quite remote from the ordinary one, should you be so unlucky (or lucky) as to be maimed or killed by a railroad accident. The law not only estimates your value as a whole, but also, on occasion, values your members separately. The old law of an eye for an eye and a tooth for a tooth is followed in such cases, only, the railroad corporation having no body as well as no soul, it cannot sacrifice a member to satisfy a loss which it has caused, and therefore it must pay its money value; and so judge and jury are frequently asked to estimate the value of one's tooth, toe, eye, nose, etc. This is as it should be, doubtless, but it is interesting to notice the peculiar valuations put upon different members by different juries. A gentleman has recently recovered from a Long Island company the sum of $2,000 for one of his toes. Now it is worth one's while to calculate the value of a man at this rate. Presuming that the gentleman had ten toes, these would be worth $20,000. No one would say that fingers are not worth more than toes, and we must add $20,000 at least for these. An ear is certainly worth as much as a toe, and a nose—especially a lady's nose—twice as much. We will add $8,000 for them. Now who will say that an eye is not worth as much as a hand? Perhaps one might lose one eye rather than one hand, but both hands would be a less loss than both eyes. Add $20,000 for these. Now here we are with the snug little sum of $68,000, and our man has yet—in bank, as it were—his teeth, legs, arms, and his whole trunk, which we may regard as a provision for his old age, or something laid up for a rainy day. Really at this rate many men would gladly lose a member or two. The losing of one hand by a railroad accident might save a man from hard work with both all his life and give him a larger fortune than he could have earned in a lifetime with all his limbs.

If railroad companies are to be made pay at this rate, we see no way for them but to adopt the plan successfully practiced by a California stage company, according to that veracious chronicler, Mark Twain, who reports a stage driver as saying, that at one time his company was much troubled by suits for for damages brought by passengers who had been tumbled down precipices in racing down the mountains, but that then all contentions of the kind were avoided by the thoughtfulness of the driver, who went around with the king-bolt after any accident, and by a timely tap on their temples put out of their misery and beyond making complaints or bringing suits such poor sufferers as were likely to survive.

THE ATLANTIC & PACIFIC RAILROAD COMPANY, having leased the Pacific Railroad of Missouri, has control of all the railroads in South Missouri west of the Iron Mountain road, except two not very long lines owned by the Missouri, Kansas & Texas, which has a contract with the Pacific, by which the latter gains all the through traffic eastward from the former's lines. This part of Missouri south of the Missouri River is about one-half of the State, part of it very fertile, part well stocked with minerals, now mined to some extent, and part not very inviting to immigrants or capital. It is now quite thinly settled, but a large part of it is growing and has room to multiply its population several times. That part near the Missouri River whose traffic goes chiefly to the Pacific has been settled longer than any other part of the State, and is comparatively well peopled and wealthy. The leased road is one of the most important in the State, connecting its two chief cities (St. Louis and Kansas City), reaching the large Kansas towns of Leavenworth, Atchison and Lawrence, having branches to two points on the Missouri—Jefferson and Sedalia—and being a direct outlet to St. Louis and the East for the Kansas Pacific and nearly all the other Kansas railroads, for which traffic it competes with the St. Louis, Kansas City & Northern and the Missouri River. The two, with the Missouri, Kansas & Texas, form a symmetrical system which reaches the largest part of the country whose trade is most sure to go to St. Louis, that city being on the direct route from such country not only to the East but to Chicago itself, which, however, is never likely to have a considerable business with South Missouri as it has with North Missouri.

It seems to be reversing the natural order of things for the older and richer company, whose road is completed, traffic large and resources abundant, to be leased by the newer one, whose road (as designed) is unfinished, and whose traffic must for some time be comparatively light, and whose profits, consequently, can hardly be so great as to guarantee dividends on the other property, should the latter's earnings chance to be insufficient. Moreover the Atlantic & Pacific is a less independent line, having no St. Louis terminus of its own, and depending for one on the Pacific, whose track it uses for 37 miles. The leased line, too, has perfected a system of branches which give it access to most of the country for thirty or forty miles south of the Missouri, which make it unlikely that a line will be made to compete with it for any considerable part of its length. But if the Atlantic & Pacific has not now many branches (it has one short one just made) it is exceedingly well situated to receive them, and there is hardly any part of Missouri either south or west of its line which can secure a railroad connection with St. Louis so easily or so cheaply as by building a branch to the Atlantic & Pacific.

SELLING PASSES, to railroad men, seems about the meanest action one can be guilty of. They will therefore be glad to know that in Pittsburgh one James Sullivan, who had obtained a trip-pass between Pittsburgh and Philadelphia, and sold it to a townsman, has been arrested, and is to be tried according to a law of Pennsylvania which makes actions of this kind misdemeanors and provides heavy penalties for them. We believe that no penalty is attached to the act in most States, it being considered lawful for one to sell anything that may be given him, even to a wedding ring; and the general feeling regarding such an act is that it is an intolerable meanness rather than a crime. The crime is rather on the part of him who buys and uses the pass. Passes are usually made out in the name of the person to whom they are granted, and are good only for the passage of that person. Any other person offering one is guilty of an attempt to obtain a ride on false pretences—that is, the pretence that he is another person.

There is, however, a very large class of persons who are virtually guilty of selling passes. For instance, the journalist, or other person, who is permitted, for reasons more or less bad, to obtain passes on request for members of his family or certain associates. Not a few of these do not hesitate to ask and obtain services for which they pay, partly or wholly, by passes. If the giving of these was a straightforward business transaction, the officer or agent of the railroad company might well ask for evidence as to the position of the person for whom the pass is asked; but as in most cases it is regarded as a favor, granted with pleasure, it is not easy to question. When asked to pay a debt, we take some pains to be sure that we owe; but when it is a "courtesy" that is requested, we cannot very well ask for a showing of accounts without destroying the grace of the action.

Probably this evil will continue until the railroad companies see their way clear to an abolition of the system.

THE UNDERGROUND RAILROAD in New York has been pretty minutely surveyed, and it is announced that the contracts will be let very soon, and the work of construction will be begun in September. As usual with railroads in cities, the company and the property-owners cannot come to terms, and this causes some delay. They come in conflict, however, only in a small district where the surface of the street is so low that the road is to be made above the ground or over it. The excavations are to be made by an open cut instead of tunneling, which will be economical, no doubt, but will be likely to completely put an end to all ordinary traffic in the streets in which the excavation is made for a considerable period, and provoke a bitter hostility on the part of the occupants of buildings on such streets. There would be an obstruction, of course, should only the work on one block be undertaken at one time, but it would not render the entire street impassable. However, the rest of the city will be likely to regard such an obstruction with great equanimity, if only the earlier completion of the thoroughfare shall be secured thereby. In such a work, when no part of the line can be productive until it is all completed, it is most economical for the company to complete the work with the utmost rapidity. If we estimate the cost at ten millions, the saving of a month in the construction would probably save $50,000 in interest alone. And if the necessary capital is obtained without difficulty, there seems to be no good reason why the work should require much time. It is a great work, to be sure, but the whole can be completed as soon as a section through a single block (in the rock cuttings) if only men enough are employed. It is not like an ordinary tunnel, in which men can be working only on two or four faces at once: here men may be placed as near together as they can work without interference all the way from the Park to Forty-second street.

FREIGHT CONDUCTORS are usually counted honest, for want of opportunities to be otherwise, if for no other reason, and in this they have the advantage of their brethren in passenger service, whom, good, bad, honest and dishonest, the world regards with suspicion, simply because of the opportunities which they are supposed to have. But we now hear of some freight conductors in Pittsburgh who have been qualifying themselves for the penitentiary in a way which will be likely to bring down upon them the contempt of mankind, inasmuch as they stole not from the companies (in which case they would have had much forbearance from the public), but from the companies' customers, which is quite another thing—for the customers. These conductors, it seems, opened freight cars in their trains, broke open packages, and appropriated such as struck their fancy. No large amount was recovered, but the extent of the robberies will probably be better known when it is found how many farms, houses, horses, jewels, etc., these gentlemen have been buying of late.

THE STEEL TIRED CAR WHEEL of Messrs. Sax & Kear, illustrated in the GAZETTE of July 6, was somewhat inaccurately described, though the illustrations will probably prevent any misunderstanding on the part of those familiar with car wheels. The plate wheel was spoken of as illustrating the thick tire, and the spoke wheel the thin one; whereas the reverse was the case, the plate wheel, however, illustrating both the thick and thin tire.

We are informed that it is not the Washburn Iron Company which is manufacturing wheels with these tires in New England, but another firm.

NEW PUBLICATIONS.

The American Artisan began a new volume with this month, very much enlarged and improved. Its pages are now almost exactly the size of those of the RAILROAD GAZETTE, and there are sixteen of them, well printed, well illustrated, and we are bound to say, better filled than they used to be. It is, indeed, a very attractive paper, and in spite of the improvements and enlargement (it is about a tenth larger than it used to be) we see that the price is still only two dollars a year; so that he must be very poor indeed who cannot now afford to have a respectable technical journal.

A Substitute for the Steam Whistle Wanted.

The following is a communication which appeared in the Boston *Advertiser* of June 6:

There are in the United States several millions of persons, sick and well, living along the lines of the various railroads, and near manufacturing establishments in populous towns, who are disturbed by day and night by the discordant shrieks of the modern steam whistle. Owing to the gradual introduction of this apparatus, the public has learned to tolerate it, but we venture to assert that if it could have been introduced suddenly as we hear it to-day, no community would have consented to its use. These unearthly sounds are made in manufactories at early dawn, at noon and at night, to call their operatives to work and to meals, and on the railroads to warn passengers on the highway and to give notice to switch-tenders on the approach of trains. It is not necessary to describe them, since they are familiar to all, and all are more or less affected by them. Is there no remedy for this increasing evil? Or cannot a substitute be found which will answer all the purposes of the steam whistle, without annoyance to the public and with safety to travelers on the railroad and on the highway? Believing that such a substitute can be found, and to encourage experiments in that direction, we hereby agree to pay the sum of ten thousand ($10,000) dollars to any one who shall, within two years from January 1, 1873, invent a system of signals which shall supplant the use of steam whistles on railroads, and which shall be pronounced by judges, hereinafter named, to be free from the evils of the present system, and which shall be attended with no discomfort to passengers on the trains, or the highways, or to residents along the line of the railroads. One-fifth of the amount thus pledged shall be paid to the author of such invention at any time within the period specified, whenever its claims shall be substantiated by the said judges, and the balance whenever the invention shall be adopted and used by a majority of the railroad companies in New England, provided such adoption be previous to January 1, 1877. The judges in these premises shall be the chairman of the Massachusetts board of railroad commissioners, the president of the Boston & Albany and Boston & Maine railroad corporations, the professor of civil engineering in the Massachusetts Institute of Technology, and the chief engineer on the Boston & Albany Railroad. If any of the above named gentlemen shall decline to serve as judges, the donors reserve to themselves the right of naming substitutes.

Communications may be addressed to "Committee on Railroad Improvements," care of Boston Daily *Advertiser*, Boston, Mass.

Chicago Railroad News.

Illinois Central.

This company reports as follows its receipts for June, 1872:

Land Department.

Acres construction land sold	2,142.78	for	$18,848 06
Acres interest fund land sold	30.85	for	154 25
Acres free lands sold	160.00	for	2.504 00
Total sales during the month of June, 1872	2,333.63	for	$21,506 31
To which add town lot sales			20 00
Total of all	2,333.63	for	$21,526 31
Cash collected in June, 1872			$57,252 20

Estimated Earnings—Transportation Department.

	In Illinois 707 miles.	In Iowa 402 miles.	Total 1109 miles.
Freight	$359.565 00	$69.473 00	$429,038 00
Passengers	103 888 15	37,083 85	140,972 00
Mails	6.375 00	3,059 33	9,434 33
Other sources	59.625 00	2.340 67	61,965 67
Total, June, 1872	$529.453 15	$111,956 85	$641.410 00
Total actual earnings, June, 1871	598,478 24	120.243 61	718,721 85
Decrease	$69,025 09	$8,286 76	$77,311 85

This is a decrease in earnings of 11½ per cent. on the Illinois lines, 7 per cent. on the Iowa lines, and 10¾ per cent. on the entire mileage.

The general officers of this company have got their official feet upon their native heath once more, since they are now fairly settled at No. 57 Michigan avenue, the old Land Department building.

Chicago & Alton.

This company has about completed a very fine building for their general offices in this city. The building is located at the west end of Van Buren Street Bridge, and is a conspicuous land mark at present, being a tall, red brick building, nearly square in form. It is 44ft. 8in. in width by 61ft. 4in. in length, and four stories in height above the basement. The walls are very thick, and special paints have been taken to avoid danger from fire. There will be three sources of water which can ordinarily be used in combination to put out a fire, should one begin in the building; and it is hardly possible to conceive of any circumstances when one of these sources of supply could not be brought to bear. There is a tank in the attic which will contain 5,000 gallons of water; there is a pipe from which water may be pumped directly from the river; and in addition to these sources is the ordinary supply from the Chicago Water Works. An iron pipe extends from top to bottom of the building in such manner that hose can be attached on any floor, and the building flooded almost in an instant. The rooms will all be large and commodious. The upper floor is so divided that the Chief Engineer will occupy the northwest corner; on the northeast corner are private consultation rooms also connected with this office; in the east is the janitor's room; the conductors' rooms are in the southeast corner, and the Purchasing Agent's room in the southwest corner.

The second floor contains the Attorney's room on the northwest, the Paymaster's room adjacent, the President's room on the northeast, the Treasurer's room on the southeast, the Superintendent's room on the southwest.

The first floor contains the General Freight Agent's room on the southwest and northwest; the east half of this floor is devoted to the General Ticket and Passenger Agent.

The basement contains the telegraph room, the engineer's room, the cashier's room, and rooms connected with the freight department. It also contains the boilers which are to heat the building, by means of what is called direct radiation. Fire-proof vaults are constructed for the use of every story in the building. The carpenter, Thomas Flannigan, is justly proud of his work, and so is the plumber, J. J. Walsh. The Chicago & Alton officials will occupy these rooms either the last of this week or the first days of next week.

The earnings of this road for the week ending June 30 were $108,839.49. The earnings for the corresponding period last year were $114,439.94—a decrease of only $5,600.45.

W. C. Van Horne, Division Superintendent of the Northern, Southern and Western Divisions of this road, has resigned to accept the General Superintendency of the St. Louis, Kansas City & Northern road, and A. M. Richards, formerly General Agent at East St. Louis, takes his place in the Chicago & Alton.

Chicago, Rock Island & Pacific.

This company opened the Atchison branch of its road on Monday, the 15th instant, for business to the East. The line will be opened next week for business in the opposite direction.

The company has received $45,439.60 insurance on its loss in the great fire, that loss being equal to $300,000.

The new passenger depot of this company in Davenport is the finest and largest in the State of Iowa.

Lake Shore & Michigan Southern.

The Lansing Division of this road is completed to Eaton Rapids, Mich., where the line crosses the Grand River Valley Division of the Michigan Central. The completion of the road to Lansing is being rapidly pushed forward.

T. J. Charlesworth, Esq., Superintendent of the Kalamazoo Division of this road, has resigned his office to take the General Superintendency of the Chicago, Danville & Vincennes road. Mr. W. Wheaton succeeds him in the Lake Shore & Michigan Southern. The latter has been, for several years, Track Master of the Air Line of the road.

Chicago, Danville & Vincennes.

This road is rapidly assuming the position of a first-class line, and is likely soon to attract much greater attention than it at present does. Its officers have been quietly at work, without letting the world know what they were doing, until they have secured arrangements, whereby they will shortly have a direct line built from

this city to Paducah. This extension is to begin at Danville, and pass thence to Charleston, and thence to Flora, from which point the road will pass directly to Paducah. The people along the line have raised money enough to grade and bridge the entire line, 240 miles in length, and they are now at work upon it, and the Chicago, Danville & Vincennes Company have entered into an arrangement to iron the road as fast as a section of 30 miles is graded, tied and bridged, and will operate the road when it is done. From Charleston, northward, the grading is mostly done.

This company has just let the contract for an extension of their Fountain County Branch to Brazil, Indiana, the entire line to be completed within 90 days. The iron for this extension is purchased, and some of it lies already upon the docks in this city. This branch will run for 40 miles through the famous Brazil coal field, and will result, no doubt, in the shipment of immense quantities of this coal to Chicago. It is believed that the coal can be delivered in this city at $4½ per ton, and if so it seems possible that it will ultimately take the place of all Eastern bituminous coals, and it cannot fail to greatly stimulate the iron manufacturing interest of this city.

This company is engaged in the building of extensive car and machine shops in Danville. The engine-house is to be built on a radius of 130 feet; a segment of 12 stalls will be constructed this summer.

The shop for the repair of engines will be 143 feet long by 72 in width. The blacksmith shop will be 50 feet in width by 100 in length; and the car shop will be 140 feet in length by 75 feet in depth, and two stories in height. The buildings will all be built of brick with stone copings and trimmings. They are to be done in October, and will cost about $75,000.

The company also design to build a new engine-house in Chicago this fall, which will accommodate about 18 engines, and a shop for repairs whose dimensions will be 60 by 100 feet.

Chicago & Pacific.

Track-laying has commenced on this road within the city limits, and the ties are down for two miles. The company are doing this work without contracting it. Fox & Howard have the contract for the bridges over the North Branch and canal. The company expect to have the road done to Elgin before the middle of October, and since it is, at first, at least, to be a road for suburban uses, the company will have a large number of stations between this city and Elgin, stationed from half to three-fourths of a mile apart.

Chicago & Northwestern.

This company is pushing the extension of the Winona & St. Peter road ahead at the rate of a mile and a half of completed track per day. The gap between Escanaba and Menomonee is also being closed in a satisfactory manner and will be completed by the advent of winter. The tunnels on the Madison extension are getting on nicely and will be completed as soon as was originally expected.

The La Crosse *Republican* says that Mr. Howe, General Manager, has assured a committee from that city that the line from Sparta to La Crosse will be built as soon as the necessary surveys can be completed. The surveying party is to begin work at once.

Pullman's Palace Car Company.

Mr. B. F. Tiffany, Superintendent of Pullman's Palace Car Company's shop in Detroit, has been transferred to this city to look after the company's interests. The company are nearly ready to begin the work of erecting large car manufacturing shops in this city.

Michigan Central.

This company dispatches daily at 6 p. m., by special freight express, Blue Line refrigerator cars for New York and Boston, for the transportation of butter and similar perishable produce.

Chicago, Burlington & Quincy.

This company has just completed a new iron bridge over the Des Plaines at Riverside, and there is now 26 miles of double track between Chicago and Aurora.

City Railroad Dividends.

The Chicago City Railway (South Side line) has declared its usual quarterly dividend of 2½ per cent. for the quarter ending with June. The West Chicago Railway Company has declared 2½ per cent. for the quarter ending June 15, and, on June 1, paid an extra dividend of 5 per cent. Afterwards it declared another dividend of 2½ per cent. payable July 15. Since December it has paid dividends amounting to 17½ per cent. The North Chicago Company has paid no dividends since the fire, the quarter through which its lines run having been almost completely destroyed.

Chicago & Northwestern.

The Milwaukee *Wisconsin* reports as follows the condition of the work on the Menominee Extension: Eight miles of the road, from the Menominee north, are graded; the next twelve or thirteen miles is nearly all chopped out and some grading done; and a gang is at work west from Ford river, having some four miles of the timber chopped out. Every effort will be made to get the road through the coming fall.

MISCELLANEOUS.

—A man sued the Lake Shore & Michigan Railway Company for $3,800, the alleged value of four packages of household goods which he had shipped on that company's road. As no trace could be had of the packages, and no evidence but that of the man and his friends could be had concerning their value, the case seemed to be in a fair way to go against the company, when suddenly they were discovered, and the contents found to be worth not more than $100.

—Mr. William L. Newman, who was long connected with the Chicago & Alton Railroad, for some time as Western Passenger Agent, has been appointed General Agent of the Mobile & Ohio Railroad with head quarters in St. Louis.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

—The following are the officers of the Erie Railway Company chosen July 9 by the new board: President, Peter H. Watson; Vice-President, Alexander S. Diven; Treasurer, W. W. Sherman; Secretary, H. N. Otis; Counsel, S. L. M. Barlow. All these were re-elected except Mr. Watson, who succeeded Gen. John A. Dix.

—Mr. George H. Heafford has been appointed Assistant General Passenger agent of the Missouri Pacific and Atlantic & Pacific railroad companies, in place of Mr. L. P. Farmer, resigned. Mr. Heafford has been for some time Chief Clerk in the General Ticket Office of the Chicago & Northwestern Railway, and is an experienced and capable man.

—The first annual meeting of the stockholders of the Lake Shore & Tuscarawas Railroad Company was held July 10, when the following were elected Directors: W. S. Streator, James Mason, J. F. Card, H. M. Claflen, R. B. Dennis, R. L. Chamberlain, of Cleveland; E. G. Loomis, Wadsworth; Clement Russell, Edwin Bayliss, Massillon; S. Harmount, Canal Dover; Thomas Moore, New Philadelphia. W. S. Streator was elected President, William H. Groat, Secretary, and S. T. Everett Treasurer. These are all re-elections, with the exception of Mr. R. B. Dennis, who takes the place of Mr. T. W. Chapman.

—Mr. C. W. Witbeck, who has been for several years Superintendent of the First Division of the Atlantic & Great Western Railroad, and who resigned that position some months ago, has been appointed Superintendent of the Western Division of the Missouri Pacific, with headquarters at Kansas City.

—Mr. C. Caligan has been appointed Master of Transportation for the Buffalo Division and the Niagara Falls & Suspension Bridge Branch of the Erie Railway.

—Mr. J. M. Fisk has been appointed Master of Transportation for the Rochester Division and the Attica and Dansville & Mt. Morris branches of the Erie Railway.

—E. H. Coffin, late operator and ticket agent of the Missouri Pacific at Kansas City has been appointed General Freight and Ticket Agent of the new Kansas Central Railway.

—A circular from President Blackstone, of the St. Louis, Kansas City & Northern Railway, dated July 10, announces that Col. W. R. Arthur having resigned the office of General Superintendent, to take effect on July 15, W. C. Van Horne has been appointed to that office as his successor, and was to assume the charge on that day. Mr. Van Horne has been Assistant Superintendent of the Chicago & Alton Railroad.

—Leslie P. Farmer, for some time the Assistant General Passenger Agent of the Missouri Pacific and Atlantic & Pacific roads, has received the appointment of Assistant General Passenger Agent on the Pennsylvania Railroad, with headquarters in Philadelphia. On announcing the retirement of Mr. Farmer, Mr. E. A. Ford, General Passenger Agent of the roads, says: "Mr. Farmer is a young man of bright promise. He leaves us to receive worthy promotion, and carries with him our earnest wishes for a full measure of prosperity, and our hearty thanks for the entirely competent and efficient manner in which he has performed his duties while connected with these companies."

—Mr. Samuel Woodward, late Day Train Dispatcher on the Eastern Division of the Missouri Pacific, has been appointed Superintendent of Telegraph and Chief Train Dispatcher of the Missouri, Kansas & Texas Railway.

—Mr. George H. Ellery, of New York, has been elected President of the Lake Erie, Evansville & Southwestern Railway Company in place of G. N. Carleton, resigned, and Robert Pattison, Vice-President, in place of John J. Chandler, deceased. Mr. Henning was chosen a director to fill a vacancy. John H. Blish was appointed Chief Engineer and William S. Ford, Assistant Secretary. Mr. Ellery, the new President, has been prominent in the organization of several successful corporations in Southern Indiana and elsewhere, and is well known as President of a telegraph company which had an extensive system of lines in the South.

—The receipts of the St. Louis, Kansas City & Northern Railway for the first week in July, were: 1872, $81,027; 1871, 40,857; increase, 100½ per cent.

—Mr. T. J. Charlesworth, Superintendent of the Kalamazoo Division of the Lake Shore & Michigan Southern Railway has received an appointment as General Superintendent of the Chicago, Danville & Vincennes Railroad.

—Mr. W. Wheaton, late Track Master of the Air Line Division of the Lake Shore & Michigan Southern Railway, has been appointed Superintendent of the Kalamazoo Division, in place of T. J. Charlesworth, resigned.

TRAFFIC AND EARNINGS.

—The earnings of the St. Louis & Iron Mountain Railroad for the month of June were: 1872, $180,786.00; 1871, $114,786.61; increase, $65,999.39, or 57½ per cent. The earnings of the same road for the first six months of the year were: 1872, $1,059,132,41; 1871, $755,269.86; increase, $303,862.55, or 40½ per cent.

—The receipts of the St. Louis, Kansas City & Northern Railway for the first week in July were: 1872, $81,927; 1871, $40,857; increase, $41,070, or 100½ per cent.

—The receipts of the Great Western Railway of Canada for the week ending June 21 were: 1872, £21,043; 1871, £18,709; increase, £2,334, or 12½ per cent.

—The receipts of the Grand Trunk Railway for the week ending June 22 were: 1872, £34,800; 1871, £33,800 increase, £1,000, or 3 per cent.

—The estimated earnings of the Erie Railway for the first week in July were: 1872, $358,451; 1871, $396,341; decrease, $43,490, or 11 per cent. The earnings of the Erie Railway for thirteen weeks from April 1 were: 1872, $5,143,223; 1871, $4,592,761; increase, $550,462, or 12 per cent.

—The following earnings for June are reported: Atlantic & Great Western: 1872, $435,501; 1871, $369,010; increase, $66,491, or 18 per cent. Chicago & Alton: 1872, $435,192; 1871, $466,097; decrease, $30,905, or 6½ per cent. Lake Shore & Michigan Southern: 1872, $1,311,110; 1871, $1,140,916; increase, $170,194, or 15 per cent. Michigan Central: 1872, $505,314; 1871, $427,076; increase, $78 238, or 18½ per cent. Milwaukee & St. Paul: 1872, $594,769; 1871, $658,017: decrease, $63,248, or 9½ per cent. Missouri, Kansas & Texas: 1872, $143,113; 1871, $70,735; increase, $72,378, or 102½ per cent. Ohio & Mississippi: 1872, $249,911; 1871, $197,108; increase, $52,803, or 26¾ per cent. St. Louis, Alton & Terre Haute: 1872, $130,079; 1871, $139,769; decrease, $9,690, or 7 per cent. Toledo, Peoria & Warsaw: 1872, $94,529; 1871, $86,860; increase, $7,662, or 8¾ per cent. Toledo, Wabash & Western: 1872, $462,868; 1871, $439,515; increase, $23,353, or 5½ per cent.

—The earnings of the Burlington, Cedar Rapids & Minnesota Railroad, for the month of June, 1872, were $74,242.

—The following were the earnings of the Central Pacific Railroad Company:

For the month of June,	1872		$1,228,140
For the month of June,	1871		795,176
For the month of June,	1870		720,874
Increase this year over	1871	(53 per cent.)	436,964
Increase this year over	1870	(67½ per cent.)	493 666
Earnings first 6 months,	1872		5,592,483
Earnings first 6 months,	1871		4,044,883
Earnings first 6 months,	1870		3,427,366
Increase this year over	1871	(38 per cent.)	1,547,601
Increase this year over	1870	(63 per cent.)	2,165,117

—The receipts of the St. Louis, Kansas City & Northern Railway for the second week in July, were: 1872, $68,918; 1871, $41,706; increase, $27,212, or 65¼ per cent.

PERSONAL.

—Mr. B. F. Tiffany, Superintendent of the Pullman Palace Car works in Detroit, has received a present of a silver tea set from the employes of the works. He is to remove to Chicago to take charge of the Pullman shops there when they are completed.

—The Portland *Press* announces that Mr. James M. Lunt has resigned his position as Superintendent of the Maine Central Railroad, to take effect next October. Mr. Lunt was formerly Superintendent of the Columbus, Chicago & Indiana Central Railway, about the time that corporation swallowed the Great Eastern. He was Superintendent of the European & North American during the construction, and has been connected with the Maine Central only a year or so.

OLD AND NEW ROADS.

[Continued from page 307.]

Burlington & Missouri River.

The sales of this company's lands in June, 1871, were: 30 sales in Iowa, 1,758 acres, average $11.55, $20,312.82; 94 sales in Nebraska, 13,663.77 acres, average $8.54, $116,791.82; 124 sales in June, 15,421.78 acres, for $137,103.97; 1,976 sales in Iowa, 169,550.17 acres, average $11.73, $1,989,324.46; 1,749 sales in Nebraska, 229,963.07 acres, average $8 50, $1,952,546 80; total sales in Iowa and Nebraska, 399,513.24 acres, amounting to $3,941,871.26.

Quincy, Missouri & Pacific.

It is reported that sufficient iron to complete this railroad to Kirksville has been purchased, and that the road will be completed to that point within 60 days.

Cincinnati & Terre Haute.

The line of this road, as located, extends southeastward from Terre Haute for about forty miles, and thence nearly due east through Bloomington to Columbus, 50 or 60 miles, and from Bloomington east by north to Greensburg, 27 miles. At Greensburg, the Indianapolis, Cincinnati & Lafayette road will afford it about as good an entrance into Cincinnati as can be made. To this point it is intended to have the road completed by the end of the year. About 25 miles of track is now laid, from Terre Haute southeast.

Union Pacific.

The sales of the Land Department of the Union Pacific Railroad Company for the month of June, 1872, were 23,900 acres, amounting to $103,610, at an average of $4.30 per acre. The total sales from July 28, 1869, to the present date are 571,169 acres, amounting to $3,399,410, at an average of $4.20 per acre.

New Maryland Railroad Companies.

The following railroad companies have been duly incorporated and their charters recorded in the Executive Department at Annapolis:

The Baltimore & Pennsylvania Railroad Company, narrow gauge, from Baltimore to Delta on Pennsylvania line, through Baltimore and Harford counties; capital stock, $300,000.

The Baltimore, Pimlico & Pikesville Railroad Company, from Baltimore to Pikesville; capital stock, $40,000.

The Baltimore & Randallstown Railroad Company; capital stock, $40,000.

Baltimore, Catonsville & Ellicott's City Railroad Company; capital stock, $250,000.

Bay Extension Railroad Company, from present terminus Kent County Railroad Company to extend to Rock Hall, on the Chesapeake Bay; capital stock, $125,000.

Lake Ontario Shore.

The Rochester *Union*, of July 1, says: "The action of the directors of the Lake Ontario Shore Railroad in locating their road through Charlotte, has created dissatisfaction throughout the proposed line of the road except, perhaps, at Oswego. The town of Webster, for instance,

issued her bonds in the sum of $75,000, on the express understanding that the road was to come to Rochester. A number of citizens who were opposed to the principle of bonding commenced legal proceedings to restrain the issue of the bonds. This suit has just been determined in the General Term of the Supreme Court in favor of the town. A few days since the company sent to the Commissioners of the town for the bonds, but it is stated that the Commissioners refused to deliver them, claiming that the company had not done as it agreed, viz.: run the road through this city. The people are thoroughly opposed to going to Charlotte. Saturday the engineers of the company were running the line through Webster, and one or more citizens pulled up the stakes as fast as they were driven. One of the engineers assaulted one of these men, and the consequence is that he is under arrest for assault, and a trial is to be had to-day before a Justice of the Peace.

Chicago & Northern Pacific Air-Line.

This Company have established their New York offices at Nos. 74 and 76 Wall street. It is its intention to begin work on the section between Geneva and Jefferson, Wis., about the 10th of August. Jefferson, Wis., votes on the 20th inst., on a proposition to subscribe $50,000 in aid of this road, issuing the bonds of the town to that amount. Whitewater, Sugar Creek, La Grange, Elkhorn, and Geneva will also vote on the same question between the 23d inst. and 7th proximo.

Milwaukee, Manitowoc & Green Bay.

This road was completed a few days ago to Kaukauna, where it forms a junction with the Chicago & Northwestern, eight miles north-east of Appleton, Wis., and 21 miles north of Green Bay. The road is now complete from Kaukauna to Manitowoc.

Old Colony Railroad.

The branch from Monument on the Cape Cod road south to Wood's Hole, along the east shore of Buzzard's Bay, will be open very shortly. This branch is about 18 miles long, and is designed especially to accommodate the travel to Martha's Vineyard. A ferry about five miles long will connect Wood's Hole with Holmes' Hole, on the island. An attempt is being made to change the Mansfield & Framingham trains to this route, by way of the Middleboro & Taunton Railroad.

New York & New Haven.

This company is about to build a new and costly depot in New Haven. It is to be hoped that the platform of the new depot will be more accessible and better supplied with air and light than that of the present one.

Hartford & New Haven.

The stockholders are to hold a special meeting at Hartford, July 31, to consider the agreement for the more complete consolidation of their company with the New York & New Haven.

Sugar River.

The track of this road is now laid beyond the east line of Claremont, and the last bridge is nearly completed.

Philadelphia & Erie.

Our Williamsport correspondent writes: "On Thursday night, July 11, midnight, the bridge known as 'Turkey Run Bridge,' about one mile east of Muncy, was destroyed by fire. It was a 40-foot span Howe truss bridge, covered with tin. By 8.10 the same morning, eight hours after the bridge took fire, it had been trestled and trains passing on time. The fire is supposed to be the work of an incendiary."

Milwaukee & St. Paul.

This company is fencing its entire line in Minnesota north from Austin.

Cannon River.

Surveys for the line of this road are now being made by Major A. B. Rogers. The route, *via* Faribault and Red Wing is the first to be surveyed.

Minnesota & Northwestern.

The Mankato *Union* says the ironing of this road has been indefinitely postponed, it being impossible to obtain the iron at present. The bonuses, amounting to $175,000, will be lost, as the road will not be completed by August 1, according to contract.

Grand Rapids & Bay City.

Work on this road between Wenona and Midland is progressing rapidly, nearly one-half the grading being finished. It is expected that the track will be laid by December 1.

Canada, Michigan & Chicago.

It is reported that $2,000 per mile has been guaranteed to this road over the distance between Lansing and Saugatuck.

It is reported that the interests of the Michigan Midland have been consolidated with those of this company and that the section between St. Clair and Ridgway will be completed very shortly.

Atlantic & Pacific.

The shares of this company, aside from the holding of the President, are distributed as follows, according to the report of the California Commissioners: Francis B. Hays, director, owns 8,184 shares and holds as trustee 4,891 more; Frederick Billings is the largest stockholder; Uriel Crocker, of Boston, owns 6,240 shares; Joseph Brown, Mayor of St. Louis and President of the Pacific Railroad Company of Missouri, owns 1,025 shares, and is a new director; Charles J. Morrill, a merchant of Boston, owns 3,795 shares; Oliver Ames, one of the largest of the Union Pacific stockholders, owns 6,576 shares; Andrew V. Stout, President of the Shoe and Leather Bank, New York, owns 3,923 shares; Joseph Seligman, a New York banker, owns 6,678; Jacob Sleeper, of Boston, late in the clothing business, 5,928; Ozias Bailey, of White Cloud, Kan., formerly engaged in pork-packing, 9,246; George S. Curtis, of Boston, a produce merchant, 774 shares; William H. Coffin, of St. Louis, formerly a New York merchant, 5,690 shares. All of these are directors, elected at the last annual meeting, May 30.

Green Bay & Lake Pepin.

Work is now progressing all along the line of this road from Northport, Waupaca County, west to Plover, in Portage County, Wis. Iron for the extension beyond New London has begun to arrive, and track-laying will begin at once.

Hastings & Dakota.

The iron is now laid five miles beyond Carver, Minn.; and Langdon & Co., who have the contract from Carver to Glencoe, hope to reach the latter place by the middle of August.

Michigan Midland.

It is reported that about 1,000 men and sufficient teams to keep that number busy are pushing the construction of the eastern end of this road, especially of the short line from St. Clair to Ridgeway, which is to be completed in the next sixty days.

Rockford, Rock Island & St. Louis.

The agent appointed by the German bondholders to visit this country and examine into the affairs of this company reports that he was given every opportunity to examine the books and accounts of the company. President Cable told him that the trouble was the excessive cost of the road—that the capital account was made to stand at nine millions, when four or five millions would have been sufficient to build the road. The location of the road in its northern part is described as altogether wrong, and the rebuilding of a section is declared necessary. To the faulty location is ascribed the necessity of using a section of the Peoria & Rock Island road, for which a rental of $31,000 is paid. There is also an oppressive contract for the use of the Indianapolis & St. Louis Railroad between Alton and East St. Louis, $60,000 a year being paid for the use of 21 miles of road for through traffic. Mr. Cable would not agree to pay one-half of the interest on the bonds as it becomes due hereafter, because he did not think the company would be able to keep such a promise. He expects that the property will have many difficulties to pass through for a year or two or more, and asks forbearance on the part of the bondholders. But he is convinced that in later years there will be recompense for the delay.

The March receipts were $98,101.36.

Peninsular of Michigan.

For the protection of the interests of the bondholders, an association has been formed in Amsterdam, Holland, to act in common toward the delinquent company, and, in case of necessity, to send the bonds to America to secure foreclosure of the mortgage.

Lake Erie, Evansville & Southwestern.

At a meeting of the directors of this company in Evansville, Ind., July 10, the contract made with the New York Construction Company, N. H. Decker, Esq., President, and H. B. Hanson, General Superintendent, by the Executive Committee, was approved and confirmed.

Indiana & Illinois Central.

The President of this company has published a card in which he contradicts a report that the road has been sold or leased to another company. He says it will be built through Parke County, Ind., early in 1873, if the subscriptions made are paid and the right of way given, while the road in Illinois is in progress and will soon be completed.

Atlantic & Pacific.

On the 12th $120,000 was subscribed in San Francisco to the stock of this company.

San Francisco & Colorado.

This is the name of a company organized in San Francisco July 12, to construct a railroad from San Francisco to the Colorado near the southeast corner of the State, where it is to connect with the Texas & Pacific. The Central Pacific has two lines in progress which will make each a connection.

New Mail Routes.

On the 13th, the Postmaster General ordered an extension of mail service on the Denver & Rio Grande Railway from Colorado Springs to Pueblo, 43 miles, beginning July 22, at $2,150 per year; and on the Burlington & Missouri River Railroad in Nebraska, from Harvard to Lowell, 46 miles, at $2,000 per year, beginning August 1.

An extension was ordered July 11 on the short branch of the Milwaukee & St. Paul Railway from Corona to Decorah, Iowa. This branch has been in operation some years.

Atchison, Topeka & Santa Fe.

Mr. A. A. Robinson, the Engineer of this railroad, writes to us as follows of the progress of construction and the prospects of the road. His letter is dated from the engineers' camp, July 5.: "The Atchison, Topeka & Santa Fe Railroad is progressing steadily towards the western boundary of Kansas. The track has reached Raymond, 62 miles west of Newton, and is being laid at the rate of 1¼ miles per day. The grading and masonry is nearly finished to Fort Dodge, 162 miles from Newton and 294 miles from Topeka. The location will be finished to the west line of the State by August 1. Contracts are to-day let on 28 miles of earthwork and masonry, and on July 25 50 miles more will be put under contract. It is expected that the road-bed will be ready for the superstructure to the State line by October 1.

"The route of location chosen is in the valley of the Arkansas River from Newton west to the State line, excepting one cut-off between Fort Larned and Fort Dodge. Here the line passes over the divide south of Pawnee Fork, between Big and Little Coon creeks, descending to the valley again near Fort Dodge, saving eight miles over the river route, with easy grades and good alignment.

"The Arkansas valley is a beautiful valley, and all who visit it are delighted with its soil and climate. It is fast settling, and seed sown late on breaking has produced growths that promise a good return. At the present rate of settlement there will not be a government claim in the valley as far west as the State line in twenty-four months. At present the unoccupied lands afford luxuriant pasturage for large herds of Texas cattle.

"By the close of 1872 this company will have in operation about 450 miles of line. When the road is completed to the western boundary of the State it will operate 480 miles of line. On this date the company owns 268 miles of completed line."

Jacksonville, Pensacola & Mobile.

Mr. J. M. Baker, appointed receiver of the Florida Central section of this road, has been discharged by one court and appointed by another, and was at latest advices in charge of the line between Jacksonville and Lake City.

Missouri, Kansas & Texas.

This road is now completed to Limestone Gap, in the Chickasaw Nation, about 20 miles beyond Perryville, the late terminus, and 60 miles from Sherman, Texas. It is now stated that the road, instead of going to Sherman, will strike a point some ten miles east, where a new town will be built, to be called Red River City. An average of 200 car loads of cattle a day are running over the road from Perryville.

National Railway.

Adam Driesbach & Co. advertise for proposals for all the grading and masonry of this railroad between Bound Brook, N. J., and the Delaware River, including a branch to Trenton, to be handed in to that firm at Bound Brook or to the railroad company at No. 218 South Fourth street, Philadelphia, by 6 o'clock p.m., July 20. The awards will be made at Yardleysville, Bucks County, Pa., July 22.

New Jersey Railroad.

The facilities for commuters on the New Jersey Railroad between New York and New Brunswick have been considerably improved since the Pennsylvania Railroad Company assumed the management. A large number of new and commodious cars from the Altoona shops have taken the place of the antique and ill-ventilated ones so long in use on this route, and the number and speed of the trains has been increased. The issue of monthly commutation tickets at prices not very greatly in advance of the yearly rate, or a little more than a cent per mile, we noticed recently. This innovation meets with much favor, as heretofore commutation tickets by this road and the New Jersey Central have not been issued for less than three months, and these at a rate nearly double that charged for a year. The new arrangement will enable many of the poorer classes to patronize the road, who are usually not able to spare the cost of a yearly ticket at one time.

Central of New Jersey.

The suburban traffic on this railroad has increased very largely within the past two years. The schedule adopted July 10 shows 45 passenger trains each way daily between New York and Elizabeth. From 3:45 to 6:30 p.m. trains leave New York every 15 minutes. The running time of the afternoon express trains from Jersey City to Elizabeth is now only 20 minutes including two stops, the distance being nearly 12 miles. The popularity of this route is due to its liberal accommodations, unvarying punctuality and generally excellent management. Tue 5:45 p. m. train on this road has been equipped with the Westinghouse brake. Ten trains are now run each way daily between Elizabeth and Newark over the new branch. The distance by this route is 9 miles, 4 miles farther than by the Pennsylvania Railroad.

Perth Amboy & Elizabethport.

The grading of this Railroad is going forward rapidly. The country through which the road passes is nearly level, and the work is in consequence light. The track of this road crosses the New Jersey Central at grade just west of Elizabethport station, and intersects the Newark Branch of that road a short distance above. The Perth Amboy trains will run to Jersey City by the way of the Newark Branch to Brill's Farm, and thence over the Newark & New York Railroad. Work is also actively going forward on the section of the road between South Amboy and Long Branch, which, in connection with the Perth Amboy road, will form an all-rail route to Long Branch. It is expected that the whole will be completed and in operation within a few months.

Chicago, Clinton & Dubuque.

This road was completed from Dubuque to within two miles of Sabula, Iowa, July 11. The excessively hot weather has seriously impeded the progress of the work.

Chicago, Dubuque & Minnesota.

This company is about to commence running a steamboat on the Mississippi between Lansing and La Crosse, to connect with its trains at Lansing and those of the Milwaukee & St. Paul road at the latter point.

Baltimore & Ohio.

This company is surveying the line from Pittsburgh to this city, and will commence within a short time to build the section of road which will connect Chicago with their Lake Erie Division (Sandusky to Newark). In this way an eastern line will be completed, and the more direct route between this city and Pittsburgh will be built afterwards. The line will probably touch Defiance and will extend about half way between the Pittsburgh, Fort Wayne & Chicago line and the Lake Shore & Michigan Southern. It is not yet decided exactly on what line the road will enter this city.

Montpelier & Wells River.

The grading of this road is nearly completed. The engineer reports that the entire line will be ready for the iron by the middle of July, with the exception of two bridges at Montpelier. It is expected that the road will be completed by the fall.

Hartford & New Haven.

The Hartford *Times* says: "The $1,500,000 recently paid in on the scrip stock of the Hartford & New Haven Railroad Company has not yet been distributed among the stockholders. We look for some action in the matter very soon after the adjournment of the Legislature. Commodore Vanderbilt is the leading shareholder, and we believe the largest stockholder in our Hartford & New Haven road, and those holding a smaller interest in the

property look for a large dividend. The affairs of the company are in a most prosperous condition, their cash dividends having been $133 per share the past ten years, to say nothing of stock dividends and the very large increase in the value of property. By the last report (1872) we find debts due the company amounting to $528,665-62; cash on hand $116,217 95; 2,000 shares of the stock of the company, worth at least $300,000. The equipment of engines and cars alone is $800,000, while the resources of the concern have increased from $4,185,054-97, nine years ago, to $6,747,085 65 the present year. The present division of earnings is 57 per cent. to the New York & New Haven road, and 43 per cent. at this end. The consolidation cannot be delayed much longer."

Jackson, Lansing & Saginaw.

The Detroit *Tribune* says of the extension of this road: "Trains are now run regularly to the village of Wells, a town recently located and built by the railroad company. The village is in the northeast township of Bay County, and is distant 40 miles from Wenona. Iron is laid on the road as far north as the station of Spring Vale, at the crossing of the railroad with the Tawas & Houghton State road, some 12 miles beyond Wells. There are now some 500 laborers engaged at different points on the line, and it is expected to have the track laid to the main branch of the Au Sable River in Crawford County [about 45 miles from Wells and 95 from Saginaw], by September 1. The road is to run north past Otsego Lake, a beautiful sheet of water, and from this point north to Mackinaw. Work is being laid out and pushed forward rapidly. Trains will be running the entire distance before another year is passed."

Long Island Central.

The first train passed over this road July 10.

Pawtuxet Valley.

It is reported that sufficient subscriptions have been obtained to insure the construction of this road, and that it will be put under contract at once. The road is to run from River Point, R. I., through Clyde, Phœnix, Lippitt, Arkwright, Harrisville, Jacksonville, to Hope Village, up the north branch of the Pawtuxet river.

Zanesville, Frazeysburgh & Londonville.

This company has filed its certificate of incorporation with the Secretary of State of Ohio. It is organized with a capital stock of $500,000 to construct a railroad through Muskingum, Licking, Coshocton, Knox, Holmes and Ashland counties. The corporators are T. J. Maginnis, H. E. Cook, Edward Ball, D. B. Linn, E. S. Garner, T. E. Sturgeon, Daniel Hattan, John M. Lane and E. L. Lemert.

Toledo, Kokomo & St. Louis.

This company filed its certificate of incorporation with the Secretary of State at Columbus, Ohio, July 11. The company is organized with a capital stock of $1,000,000, to build a road from Toledo through Lucas, Wood, Henry, Defiance and Paulding counties to the village of Paulding, and from thence to the west line of Paulding County where a straight line from Paulding to Monroeville, Indiana, would intersect the line between Ohio and Indiana. The corporators are F. M. Rummell, Charles Hakes, David C. Carey, Joshua Blank, A. H. Selden, V. V. Pursel, J. A. Ferguson, Peter Hilty and Bennet Savage.

Cairo, Arkansas & Texas.

The Missouri *Republican*, of July 11, says: "The contract has been just let for the construction of the Cairo, Arkansas & Texas Railroad, formerly known as the Cairo & Fulton road of Missouri. The road will be between 60 and 70 miles in length, running from Cairo through Charleston in Mississippi County, and thence west to the intersection of the Cairo & Fulton of Arkansas.

Col. H. J. Deal of Charleston has the entire contract for building the road, and received orders yesterday from Thomas Allen, through Decatur Axtell, the Chief Engineer, to proceed at once with the work. The Cairo & Fulton road it will be remembered was built in 1858 and 1859, and 26 miles of it, from Cairo west to Sikeston, in Scott County, was put in running order. After the commencement of the war, the government took possession of the road and run it awhile. It was afterwards sold by the State and bought in. It was then sold to McKay, Reed & Co., and by them sold to Thomas Allen, in whose hands it is now."

Weston & Iowa.

The Leavenworth *Commercial* says:

"The proposition to vote $60,000 bonds to the Weston & Iowa Narrow-Gauge Railway was carried by a large majority in Weston, on Tuesday. The route, as now surveyed, starts from the city of Weston, in Platte County, and runs by way of New Market and Arnoldsville to the DeKalb County line, from whence it will be built by local subscription to the Iowa State line."

St. Louis, Jefferson City & Fort Scott.

Captain G. C. Waite, Chief Engineer, has commenced the survey of the line of this proposed narrow-gauge road. The line is to run from Fort Scott northwest to Appleton City, Mo.

Selma, Marion & Memphis.

A large force of men is employed on this road near Holly Springs, Miss. At the other end of the road, the bridge over the Black Warrior River, near Eutaw, Ala., is going ahead rapidly.

Petersburg Railroad.

A correspondent of the Norfolk *Journal* says that some time ago Mr. Reuben Ragland and others purchased from the City Council of Petersburg the stock of that city in the Petersburg road, from Petersburg to Weldon. "At the last annual meeting of the stockholders of the company the Ragland party, having control of the majority of the shares of stock, elected Mr. Ragland President, and voted him an annual salary of $12,000, and recognized a claim on the preferred stock, bought from the city of Petersburg, of 3 *per centum per annum* dividend accruing ever since some time in 1843, when an act of Legislature was passed authorizing the issue of the stock, and stipulating that the 3 per cent. dividend should be paid, etc. This claim, thus allowed, amounted to within a fraction of $250,000." Soon after certain of the other stockholders, including Messrs. D. B. Tennant, A. G. McIwaine, G. W. Bolling, A. Kenan, Z. W. Pickerell, James Dunlop, *et als*, filed a bill in chancery here in our circuit court, praying for an injunction against President Ragland in the matters above referred to. A temporary injunction was granted, but, pending the hearing before the Court as to whether the injunction should be dissolved or not, Mr. Ragland and his associates offered to compromise, by purchasing the stock of the complainants at a fair valuation. The compromise has been accepted, only some small matters of detail remaining to be arranged, when the correspondent wrote.

Report of the Michigan Central Railroad.

The Michigan Central Railroad Company operated during the past fiscal year (closing May 31, 1872) the following lines and branches:

	Miles.
Main Line—Detroit to Chicago	284
Air Line Division—Jackson to Niles	103
Grand River Valley Division—Jackson to Grand Rapids	97
Jackson, Lansing & Saginaw Division—Jackson to Wells	144
Kalamazoo & South Haven Division	32
South Bend Division—Niles to South Bend	10
Joliet Division—Lake Station to Joliet	44
Total	714

The company during a part of the year at least also operated a section of the Chicago & Michigan Lake Shore Railroad, under the name of "Nunica Division." The company owns only the main line, but it has done a large part of the construction of its leased lines, and owns stock of some.

We are reluctantly compelled to abridge materially both the President's and the Superintendent's report, which are of exceptional interest.

The following comparative statements of earnings and expenses for the entire property and for the main line and each branch separately is from the Superintendent's report:

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES OF ENTIRE LINE, INCLUDING BRANCHES.

	1871.	1872.	Increase or Decrease.	Per cent
Earnings.				
Passengers	$1,912,278 07	$2,114,066 44	+$201,788 37	10½
Freight	3,329,630 70	4,046,198 76	+716,568 06	21½
Miscellaneous	178,214 62	281,147 36	+102 932 74	57½
Totals	$5,420,123 39	$6,441,412 56	+$1,021,289 17	19
Expenses.				
Operating expenses	$3,774,850 51	$4,377,614 39	+$602 763 88	16
Taxes	86,160 84	70,189 07	—15,971 77	—18½
Totals	$3,861,011 35	$4,447,803 46	+$586,792 11	15
Ratio of expenses to earnings, including taxes	.71 11-100	.70 64-100	—.0 47-100	
Exclusive of taxes	.69 98 100	.67 96-100	—.2 02-100	

SEPARATE EARNINGS AND EXPENSES OF THE MAIN LINE AND BRANCHES.

	Gross Earnings.	Expenses.	Net Earnings.	Percentage of Exp'ns's.
Main line	$5,313,074 03	$3,719,348 67	$1,593,725 36	70
Joliet Division	121,736 00	158,562 01	—36,826 01	130
Grand River Valley Division	271,074 33	133,616 50	137,457 83	49¼
South Haven Div.	90,391 32	3,422 8	86.968 52	37
Air Line Division	116,989 62	123,335 26	—6,345 64	105½
Nunica Division	26,768 78	16.061 27	10,707 51	60
South Bend Div.	17,235 90	8,800 19	8,435 71	51
Jackson, Lansing & Saginaw Railroad	484,142 58	254,656 76	229,485 82	52½
Totals	$6,441,412 56	$4,447,803 46	$1,993,609 10	70.64

COMPARATIVE EARNINGS AND EXPENSES OF THE MAIN LINE.

	1871.	1872.	Increase or Decrease.	Per cent.
Earnings.				
Passengers	$1,738,181 38	$1,687,256 49	—$50,924 89	—3
Freight	3,072,557 58	3,379,625 54	+307,067 96	+10
Miscellaneous	167,331 19	246,192 00	+78,860 81	+47
Totals	$4,978,070 15	$5,313,074 03	+$335,003 88	+6¾
Expenses.				
Operating expenses	$3,435 480 18	$3,653.574 85	+$198.094 67	+5¾
Taxes	82,724 27	65,773 82	—16,950 45	—20½
Totals	$3,538,204 45	$3,719,348 67	+$181,144 22	+5¼
Ratio of expenses to earnings, including taxes	.70 11-100	.70	—.0 11-100	
Exclusive of taxes	.69 5-100	.68 10-100	—.0 15-100	
Passenger earn'gs per mile	$6,120 35	$5,941 04	—$179 31	
Freight earnings per mile	10,818 86	11,900 09	+1,081 23	
Miscellan's earnings per mile	589 19	866 87	+277 68	
Total earnings per mile	$17.528 40	$18.708 00	+$1.179 60	

The freight earnings during the year as compared with the previous year are as follows:

	1871.	1872.	Increase.	Decrease.
Local East	$776.998 19	$8 7.0*5 16	$50,056 97	.....
Local West	717,622 92	5 4.235 98	.....	$123,386 94
Through East	1,045,579 22	4 890 071 21	434,491 89	.....
Through West	532.857 25	478,963 29	.....	54,093 96
	$3,072,557 58	$3,379,625 54	$307,067 96	.....

Percentage of local decrease	4 91-100
of through increase	24 11-10)
of through and local increase	9 99-100
of local to entire freight earnings	42 5-100
Percentage of local passenger and freight earnings to all earnings	42 12-100
The increase of tonnage on all freight amounts to	11 98 100 per cent.

Passenger earnings, as compared with the previous year, are as follows:

	1871.	1872.	Increase.	Decrease.
Local East	$436,417 43	$414,681 16	.....	$21,7?6 27
Local West	430.717 09	401.966 09	.....	28,781 00
Through East	409 8?7 90	398,236 81	.....	11 571 09
Through West	427,607 43	417,106 27	.....	10,5?1 16
Emigrants	34,631 53	55,266 16	$21,634 63	.....
Total	$1,738,181 38	$1,687,256 49	$21,634 63	$50,924 89

Percentage of local decrease	5 82-100
of through decrease	2 63-100
of emigrant increase	64 36-100
of local to entire passenger earnings	48 40-100

PASSENGER EARNINGS.

The passenger traffic has fallen off during the year, as compared with the last, $50,924.89, or 3 2-100 per cent.

The number of passengers carried is 40,144 less, being 4 93-100 per cent. less than the previous year.

The decrease in passenger earnings, as will be seen by the foregoing table, has been more largely on local than on through, while the emigrant traffic shows a fair increase.

Of the 1,308,859 passengers carried on main line and branches during the year, I am gratified to state that no one has been injured.

FREIGHT EARNINGS—MAIN LINE.

The operations of this department altogether show an increase over the previous year of 11 98-100 per cent. in tons carried, and of 9 99-100 per cent. in earnings.

The increase of earnings on east-bound freight, both through and local, has been 26 58-100 per cent., while there has been a decrease of 14 20-100 per cent. on the through and local west.

The increase of tons carried through has been 83,210 tons, or 15 94-100 per cent., and the gain in receipts 24 11-100 per cent.

The increase in tons on east-bound local has been 31,914 tons, or 10 38-100 per cent.

The local west shows an increase of 17,314 tons, or 6 25-100 per cent., and a decrease of $123,386.94 or 17 19-100 per cent. in earnings.

The Superintendent says that the Air-Line Division has been used for through freight trains east, and on through express trains in each direction, for which no credit is given it in the earnings.

Twenty-five new locomotives were added during the year and 15 were acquired with the Jackson, Lansing & Saginaw road, making the entire stock 163. Thirty new ones have been ordered and are arriving. Six new passenger cars were built in the company's shops at an average expense of $7,235.60 each, and three baggage cars were rebuilt. To the freight stock 1,135 cars of all kinds were added. The company now has 96 passenger coaches of all classes, an increase of three since 1871; 30 baggage cars, an increase of three; 3,062 freight cars. Foreign cars run on the road 18,183,254 miles, and Michigan Central cars run on foreign roads 12,620,123 miles.

The President, after giving figures for earnings and expenses, calls attention to the fact that the increase in net earnings was largely due to addition of revenue of the Jackson, Lansing & Saginaw Railroad, worked under a lease for nine months of the year. He then gives the following explanation of causes which have prevented a greater increase:

The amount, however, might have been so very much larger, but for the causes hereinafter stated, that it is very evident that the further and very large expenditures now making for double track and other additions to the ability of the road to meet the wants of business, have been delayed even longer than was required by the real interests of the road.

The statements made in the reports for several years past show, that while the earnings of the main line have been steadily increasing until limited by the ability of the road to meet the demands of traffic, the relative expenses of operation have been still more rapidly increasing, and the net earnings have been relatively less. Several causes have contributed to this result, some of which are temporary, but the more important of which arises from the fact, simply, that the increase of business has been so rapid that our improvements have not kept pace with it.

Station grounds at Chicago and Detroit, which were ample for the business five years ago, have been, the last two years, far too small. Machine shops and car-repairing shops, adequate then, have become totally unequal to the task imposed upon them now. Then, a single track did the business with ease, while now, with twice as many trains as then, it has, at times, and for long times, been impossible to get over it with despatch. Then, iron could still profitably be used for rails; now, and with such business, and especially with such a winter as the last, they must be renewed by far too often, to say nothing of the impossibility of maintaining an even and smooth track.

All these causes have been contributing to the increased operating expenses, until they amount to quite 70 per cent. of the gross business, while, with proper improvements, they should not exceed, at the outside, sixty.

It will, perhaps, be well to look a little to the past history and progress of the business, both that we may judge of the future, and also because it may perhaps show why all the appointments of the road are not equal to the exigencies of the past year or two.

In 1858 the company owned 98 locomotives, and most of them were small and light, such as were adapted to the business of the road from 1846 to that date. From that date the increase of business for the next ten years had not been sufficient to render it necessary to add a single locomotive to the power.

The number of freight cars of all kinds, in 1858, was 979, and there had been an increase of these of only fifty a year, upon an average, there having been upon the road, in 1868, in all 1,452 freight cars, of which 103 were Blue Line cars, that line then having been just formed, and making a most important era in the history of the road.

The gross earnings were as follows for the several years stated:

1858	$2,429,737 52
1859	1,838 129 69
1860	1,832,944 86
1861	2,058,052 51
During the war and up to 1867, they had increased to	4,345,490 51

Up to that time both the power and equipment were adequate to the business, and it was not till 1870 that the traffic began to exceed the fair and reasonable means of doing it.

The number of tons of freight of all kinds moved upon the road in 1859 was 235,123. This had gradually increased in eight years to 578,177 tons. The gross tonnage for the past year has been 1,238,313 tons, being considerably more than twice

as much as it was five years since, and three times that of 1862.

There is no reason to doubt that had the road been able to meet the demands of business during the past year, the increase of tonnage would have been larger than in the preceding one.

It was not easy, when the power of the road had been so long stationary, and yet equal to the traffic, to realize that it should be fully doubled in two or three years, and that in all other respects its ability, though it had already been greatly enlarged, should fall so far short.

The vast extension of railroads, west of Chicago especially, and the rapid settlement and development of great extent of country through which they run, and the consequent multiplication of all kinds of business since the restoration of peace, present a spectacle of progress perhaps unequalled at any time in the history of the country.

The result has been that during the past year all the avenues eastward of Chicago have been unequal to the task required of them, though the Michigan Central road has, perhaps, the most suffered by reason of it. There were, however, causes peculiar to the Michigan Central which added much to its embarrassment.

The Chicago fire not only destroyed all our buildings at Chicago, and all our means of handling freight there under cover for a considerable time, but created a demand for brick, lumber, and other building material theretofore wholly unprecedented and while totally unable to do the usual business of the road there, a very large traffic in those coarse articles was thrown upon it from roads connecting with it and running into the northern part of the State of Michigan. The difficulty of doing business at Chicago being so great that the cars for ordinary merchandize could not be handled there with any despatch, they were stored upon side tracks east of Chicago until they could, as their turn came, be taken in and unloaded and perhaps reloaded for their return. Adding to this the traffic, which was very large, in lumber and brick and other building material, and all the side tracks of the road for the west half of it were filled with loaded freight cars. It will be readily seen that the difficulty of doing business was very great, as well as the expense also. From 500 to 800 cars were, on the average, for the winter, waiting for entrance to Chicago.

This, however, does not comprise all the difficulties which have beset the business of the road during the year. The winter has been one of extraordinary severity and duration. The ice in the Detroit River has been so solid that for two periods, of about a month in all, it has been impracticable to send the freight across it, while it has been done with great difficulty during a period of nearly four months. During the cold weather, therefore, our east-bound cars as well as our west-bound have accumulated at Detroit on both sides of the river awaiting passage. At two periods, of about a fortnight each, this accumulation of loaded cars, going east, on the Michigan Central road, stored upon its side tracks thus waiting, has run up to 1,100 and 1,200 cars. These difficulties, both at the west and the east end of the road, have been such as no human foresight could have fully obviated. The board would, however, be glad if they had ended with the approach of spring.

The Great Western Railroad Company owns the ferry across the river and undertakes to do the business there. The great increase of tonnage has swollen the traffic to such a volume, that the boats have been unable to take it across, and since the ice passed out of the river there have been, most of the time, accumulations of loaded cars on the side track at and near Detroit, sometimes amounting to upwards of 500. This it has been totally out of the power of the officers of the company to prevent or obviate. The new boat of the Great Western Company, which should have been done during the winter, will probably soon remedy this difficulty.

If to all these causes the effect of the severe cold of a very long winter, and of the heavy traffic, in spite of all these difficulties, upon the iron rail of a single track, and of its consequently worn and rough condition upon machinery, be taken into consideration, stockholders will perhaps appreciate the position of their road and its difficulties during the last six months. So rapidly did iron give way, that even during the intense cold weather, from December to March inclusive, there had been removed and replaced 35 miles of rail, which were in good condition when the winter set in, and much of the rail not removed was much injured.

The fire in Chicago has made it possible to purchase sufficient ground for handling freight, the lack of which and the great difficulty in getting more had threatened to make it necessary to abandon the present terminus. Already some ground has been purchased and the accommodations for handling freight trebled. Enlargements of station grounds have been made in Detroit also.

Grounds have been purchased in Jackson, 76 miles from Detroit, where the Air Line, Grand River Valley Division, and Jackson, Lansing & Saginaw road meet the main line, as a site for machine shops, and these have been begun on a large scale, and some are nearly ready for use, and will afford much needed relief to the old shops. A necessity for car shops elsewhere than on the Detroit station grounds is reported, and measures have been taken to secure these.

Ninety-five miles of steel rails have been laid in the track, mostly within the past year, and 23 miles of sidings were laid in the year. The track is to be renewed with steel throughout, the rapid failure of iron having convinced the company of the necessity of steel "later than has been expedient probably for the interests of the company." The steel track is to be made to extend this year from Detroit to Jackson (76 miles), and from Niles to the connection with the Illinois Central near Chicago, about the same distance. Contracts were made last season and in the winter for 14,000 tons of steel rails.

A second track is in rapid progress between Detroit and Ypsilanti, 38 miles, and between Niles and Lake Station, 58 miles. The Air Line and the main line already supply two tracks between Niles and Jackson. There will then remain the 48 miles between Jackson and Ypsilanti to be constructed next year. The second track is to be laid with steel. With these improvements it is believed that the expenses may be reduced to 60 per cent. of the receipts, while the latter will be largely increased.

The chief causes which have limited the earnings and swollen the expenses have been sufficiently set out above. There is one, however, somewhat remarkable, where an increased business has actually both diminished earnings and also added to the expenses. Allusion has been made to the quantity of building material seeking Chicago during the winter. A large quantity of this came from the Chicago & Michigan Lake Shore road. The haulage on the Michigan Central was only 66 miles. It could not be thrown off the road, and the haulage is so short that a price adequate to the inconvenience of the business, at that time and under the circumstances, could not be charged for it. It contributed to intensify the difficulties of the winter, and though with a double track and means of doing it this traffic will be valuable, yet while the difficulties lasted this particular traffic stood in the way of the long business, and enhanced the cost of doing it also. The passenger business, however, from that road constituted a tolerably satisfactory compensation. The aggregate business furnished by that road to this company the past year has been considerably more than $100,000.

With regard to the ruinous competition between the three lines from New York westward, as limiting the receipts of this road, the last report of the Lake Shore & Michigan Southern Company is quoted, but Mr. Joy is unable to endorse the statement of that report that there is "reason to hope that better counsels may prevail," and that the warfare may not hastily be renewed. He says that the warfare seems to become chronic, and that there is little reason to hope for increased wisdom on that question. Last year the competition is reported to have destroyed totally the whole value of west-bound business for six months of the best business season of the year.

The property destroyed by the Chicago fire, including that for which the company was liable, is estimated to have been worth $250,000. Only one car was burned, and that took fire while being hauled out.

Attention is called to two new lines from the South which cross the company's main line and compete for a portion of its traffic: one in the interest of the Pennsylvania Company from Mansfield, O., northwest, crossing at Battle Creek, with a branch to Marshall, and one controlled by the Lake Shore & Michigan Southern, crossing at Albion. While no estimate is made of the extent to which these roads will affect the company's traffic, the general statement is made that "the rapid multiplication of railroads and the intense competition created thereby are affecting seriously the value of the entire railroad property of the country." The Michigan Central has endeavored to secure its traffic by obtaining the control of lines which otherwise might have crossed it and become feeders of other lines, but this policy has been defensive rather than aggressive in all cases—intended to secure the company in its old traffic rather than to take anything from other companies. At present, the report says, there is intense competition for almost all local as well as for through business, and the roads are compelled to do twice or thrice the work for nearly the same money they earned a very short time ago.

The result with this company is the necessity for making road and equipment as perfect as possible for moving the largest possible traffic at the least possible cost, and the stockholders must depend upon small profits on a large business instead of the reverse. "With the capacity and ability of the road made equal to any demand upon it, there seems good ground to hope for a future prosperity which may be equal to the past."

The improvements of the Great Western, the construction of its new line to Buffalo, the new Buffalo Bridge, and the change to the standard gauge of the Grand Trunk's line from Detroit to Buffalo are spoken of as completing a triple outlet to the East, connecting with the Erie as well as the New York Central; while the addition of the Detroit River Tunnel will make the North Shore route as complete as possible.

The funded debt secured by the main line less the sinking fund is $1,673,774, and the capital stock $17,987,048, the latter having been increased to meet the cost of improvements by $3,321,200.

The company has leased the Jackson, Lansing & Saginaw Railroad, binding itself to pay the interest on and guarantee the debt, not to exceed $18,000 per mile, and to pay a rental of $50,000 the first year, $60,000 the second, and $70,000 thereafter. It owns more than one-third of the stock of the company, and therefore that proportion of the rental is retained in its treasury.

On the first of May the company mortgaged the main line for $10,000,000, and on this has sold $4,000,000 of bands, with which to meet the cost of improvements this year, and $500,000 of bonds falling due July 18. The bonds secured by the branch lines amount to $7,845,000.

There has been expended for construction during the year, the large sum of..... $2,380,731 41

Among the items for which this has been paid are:

Lands at Chicago and Detroit.....	$70,668 50
Locomotives	292 090 13
Passenger cars.....	104.163 01
Freight, baggage and second-class cars.....	960,607 09

The net earnings for the last half year were not quite equal to the 5 per cent. dividend which was made as usual. It was thought better to make up the amount from the surplus than to interrupt the regularity of dividends, as it is probable that the earnings will be sufficient hereafter, there having been of late unusual expenditures for steel rails charged to working expenses.

"The Peculiar Merits and Advantages of the Narrow-Gauge Railway System."

At the recent convention in St. Louis of officers and managers of narrow-gauge railroad companies, a committee appointed to report on the above subject made the following declaration of principles, which may be called the American narrow-gauge case:

MR. PRESIDENT: Your committee, to whom was delegated the duty of preparing a report upon the "peculiar merits and advantages of the narrow-gauge railway system," beg leave to recommend the adoption of the following resolution:

Resolved, That having found the three-foot gauge so numerously represented in this convention, they recommend that it be adopted as the standard narrow gauge by all roads where there are no particular reasons for adopting a less gauge:

1. Because a uniform gauge is very essential to the final success of the system; and

2. Because they believe that if it is adopted on all narrow-gauge roads, that it will not be many years before the three-foot standard roads will have through connections with North, East, South and West, with a better system of interchange of cars and a less amount of transfer than there is now on the 4-ft. 8½in. on the North, the 5-ft. of the South, and other gauges now in operation.

They also recommend the adoption of 24 inches as the standard height for the center of the draw-head above the rail.

In the call for the convention, twelve points are suggested for discussion in order to elicit the fullest information in regard to both the construction and the practical operations of the narrow-gauge.

Your committee have been unable to devote as much time to the consideration of the subject as its importance demands, but have touched upon them all, and in doing so have been careful to understate, rather than overstate the capacity and numerous advantages of the new system.

I. THE WANT OF RAILWAY FACILITIES

is acknowledged by all classes, and the valid reason why any locality is without the same, is simply a financial question. All sections of the country would be in possession of railway transportation if they possessed the means or could borrow the funds at a reasonable rate of interest; and your committee believe that any system that tends surely to that end, namely: the sale of bonds at or as near par as possible, and at the standard rate of interest, is and will be of vast benefit to the public, and as the narrow-gauge will do all the business of any section of the country, with a much less bonded debt, it tends to give a better security to the bonds and stock of the roads, making a better sale for the same, and in that way furnishing many feeders to our present through lines, which would not otherwise be constructed, and soon connecting local lines so as to make new through lines of the three-foot gauge North and South, as well as East and West.

II. THE COMPARATIVE COST OF THE OLD AND NEW SYSTEMS.

Taking what are called first-class roads, equipped to do the business of the various localities through which they run, your committee feel justified in the following conclusions:

1. In very rough mountainous countries, where the transportation of heavy ores such as gold, silver, copper and other minerals in bulk, before reduced, so as to collect the same at the various smelting-works, with the coal, wood and fluxes used in the reduction and manufacture of the same, and where it is not necessary to run fast or time trains, that the cost of construction of a three-feet gauge road will not be over one-fifth of such roads as the Erie, Pennsylvania Central, and Baltimore & Ohio; and that the capacity of the cheap road can at any time be increased by capital so as to do all the business for all time to come, thereby saving a large amount in first cost and interest on the same, which is the strongest possible recommendation for capital to invest in narrow-gauge cheap roads rather than in the expensive broad-gauge.

2. That in the broken, rolling country, where most of our roads are constructed that the saving will be as about as one to two—namely, that the narrow-gauge will cost about one-half as much as the present broad-gauges have cost. Your committee would respectfully ask and earnestly urge all parties interested in the construction of railways that this part of their report be thoroughly investigated, and that the question of what the present broad-gauges have cost be examined as carefully by narrow-gauge advocates as has the question of what their roads do and will cost by the friends of the broad-gauge; not forgetting to look into the question of what broad-gauge advocates say they can do in the way of reduction of dead weight, but which none of them can afford to attempt, on account of the vast amount of capital involved.

3. That in the slightly undulating prairie or plains country, the cost of construction of a first-class narrow-gauge passenger road, with the equipment suitable for a large freight as well as passenger business, will not exceed three-fifths of what a broad-gauge would cost with what is now called first-class equipment and road-bed; and that the real comforts and safety of the narrow-gauge are fully equal to those on the three great government roads, viz.: the Union Pacific, Kansas Pacific, and the Central Pacific.

III. OUR MEANS OF CONSTRUCTING THE BROAD GAUGES AS COMPARED WITH THE NARROW GAUGE.

Railway officials are so well advised on this question, that it is only necessary to say that the obtaining of a sufficient amount of money to construct a road on a cash basis, is the only real difficulty to be overcome.

It is a self-evident fact that it is very much easier to obtain $10,000 per mile than it is $30,000.

It cannot be denied that we have numerous localities North, East, South, and West, in which railway facilities are imperatively demanded; nor will it be denied that in many instances it would be impossible to obtain the means to construct them broad-gauge; or, if able to do so, that when done they would not command sufficient business to sustain them.

Their excessive cost, entirely disproportionate to their light business, would necessarily compel them to charge high rates in order to pay operating expenses and interest account, and thus retard, rather than stimulate development.

Your committee are unable to see the propriety of thus unnecessarily taxing the industries of the country, especially when the required facilities may be obtained by the adoption of the narrow-gauge at one-half the cost, thereby placing it within the means of the locality referred to not only to provide themselves with railways but with low rates.

Admitting that $10,000 per mile will accomplish the desired object, your committee are unable to see the economy of investing $20,000 per mile, and thereby incurring the entailment of high rates for all time.

As to narrow-gauge supplies, such as rail, locomotives, cars, &c., the construction of the Denver & Rio Grande, as well as that of many other roads from twenty to one hundred and fifty miles in length, now fast being completed, and even more rapidly than most broad-gauge roads have been constructed, shows most conclusively that American skill, ingenuity and energy has been equal to the emergency.

In conclusion, upon this point, we beg leave to remark that we are clearly of the opinion that an impartial and thorough examination of the subject cannot fail to convince the most skeptical of the great advantage in favor of the narrow-gauge, in first cost, and the consequent money saving results to be obtained thereby in the more rapid development of our resources.

IV. THE COMPARATIVE COST OF OPERATING THE TWO GAUGES.

Your committee cannot find that it has ever been claimed by the broad-gauge advocates that their system can be operated for less than the narrow in any case, while the opinion and practice of all roads proves that when the business exceeds a certain extent that it is cheaper to construct a double track, the interest on the same to be added to the operating expenses.

It should be borne in mind that the double-track narrow-gauge will not cost as much as the broad-gauge single track, hence the narrow can under all circumstances furnish cheaper transportation than the broad.

In seeking to develop our resources, we must not lose sight of the fact that low rates of transportation will accomplish the desired end much more rapidly than high rates, which frequently prevent, and in all cases retard development.

In examining the question of the comparative cost of operating the two systems, we will first show the difference in the weight of the rolling stock and machinery, and then trace the effects produced in each case to a final result.

The following tables show the proportions of paying and dead weight in the cars of the two gauges when loaded to their full capacity:

Passenger Cars.

Gauge.	Weight of car in pounds.	No. Passengers. Full Load.	Pounds dead weight per passenger.
Broad.....	38,000	56	678
Narrow.....	12,000	36	333
Total.....	26,000	20	345

Pounds dead weight per passenger carried on roads in Massachusetts and New York in 1870:

Gauge.	Mass.	New York
Broad	1,250	2,784
Narrow	....	....

In this case the narrow-gauge coach, weight 12,000 pounds, carries when full 36 passengers, with a dead weight of 12,000÷36=333 pounds per passenger; while the broad-gauge coach, capacity 56 passengers, weighs an average of 19 tons, giving a dead weight of 38,000÷56=678 pounds, a difference of 345 pounds per head in favor of the narrow gauge.

But these coaches seldom run full, in which case the advantage will be still greater in favor of the narrow gauge.

To test the comparison still further, we will suppose that we have 38 passengers, two more than the small coach will accommodate, making it necessary to put on a second one.

In this case we will have two narrow-gauge coaches, weighing 24,000 pounds, or 24,000÷38=634 pounds per passenger, while by the broad gauge we have 38,000÷38=1,000 pounds dead weight per passenger, or a difference of 366 pounds per head in favor of the narrow gauge.

But let us apply still another test. We will suppose that we have two narrow-gauge car loads, 72 passengers, or 16 more than can be accommodated with one broad-gauge coach, necessitating the use of a second one.

The account will then stand as follows: Two narrow-gauge coaches, 72 passengers, 24,000÷72=333 pounds per passenger, while by the broad gauge it will be, two coaches 76,000÷72=1,055 pounds per passenger, a difference of 722 pounds per head, or a total of 52,000 pounds, or 26 tons saving in dead weight in favor of the narrow gauge in only two cars.

The dead weight per passenger on the New York roads for 1870 was 2,748 pounds, exclusive of baggage, with an average of 13 passengers per car. On a large majority of roads the average dead weight is much greater. The passenger coaches, then, on the New York roads run about one-fourth full. For the purpose of a further comparison, we will assume that our broad-gauge railways average the same number (13) per car. On this basis the table of paying loads and dead weights is arranged thus:

Kind of traffic...	Gauge.....	Number of passengers per car.	Weight of car in pounds.....	Total paying load in pounds.....	Dead weight per passenger in lbs.	Gross load, in lbs.
Passenger	Broad..	13	38,000	1,950	2,923	39,950
Passenger	Narrow	13	12,000	1,950	923	13,950
Total			26,000		2,000	26,000

A difference of 26,000 pounds, or thirteen tons, in favor of the narrow gauge, or 2,000 pounds per head for each passenger.

Assuming the weight of the broad-gauge car to be only fifteen tons, or 30,000 pounds, the difference in favor of the narrow-gauge car will still be 18,000 pounds, or 1,384 pounds per head for each passenger, as against 923 pounds per head by the narrow gauge.

Of course the traveling public pays for this excess of unnecessary dead weight, amounting to many millions of dollars per annum.

We will now compare the two gauges, in reference to the economical transportation of freight when the cars are loaded to their capacity.

Freight Cars.

Gauge.	Weight of box car, in pounds.	Capacity of box car, in pounds.
Broad	18,500	20,000
Narrow	8,000	16,000
	10,500	4,000

Average pounds of dead weight to one ton paying freight carried on railways in Massachusetts and New York in 1870:

Massachusetts	3,136 lbs.
New York	3,091 lbs.

The average weight of modern broad-gauge cars is 20,000 pounds, capacity 20,000 pounds. The average weight of Southern broad-gauge cars may be put down at 18,500 pounds, capacity 16,000 pounds. In the table we have taken the lowest dead weight and the highest capacity, as we prefer to over-estimate the capacity of the broad-gauge rather than under-estimate it.

As will be seen by the above figures, the railways of Massachusetts and New York average only about one-sixth of this capacity. It should be borne in mind that the average of our railways will fall far short of those of the States referred to. If, as shown, Massachusetts hauls 18,500 pounds of dead weight to transport 3,136 pounds paying freight, and New York 3,091 pounds, what may we reasonably expect is the average in the agricultural districts in the South, West and Northwest.

The proportion of dead weight to paying freight on Southern railways is even much greater than it is in the West and Northwest. In a word, their railways have a capacity far in excess of the business of that section, entailing high rates upon them, and thus retarding development which cheap, narrow-gauge roads, with their low rates, would stimulate into great activity. It will be observed that the average of freight carried per car by Massachusetts roads is less than one-fifth the capacity of the narrow-gauge box car.

In transporting less quantities than a full car load, the narrow-gauge cars have immensely the advantage. Cars carrying through freight may be loaded very generally to their capacity, but the average net car loads are brought down by the necessity for dropping cars from the trains at turn-outs along the route with way or local freight, frequently very small in proportion to the full car load.

The following table shows the amount of dead weight per ton, in pounds, by the two systems, when the shipment of freight to a way station is not an even car load.

The figures in the heading show the amount of supposed shipment in tons:

Dead Weight per ton in lbs. on the two Gauges.

GAUGE.	No. cars to carry shipment.....	TONS. 1	2	3	4	5	6	7	8	9	10	11
		DEAD WEIGHTS.										
Broad...	1	18500	9250	6166	4625	3700	3083	2642	2312	2055	1850	....
"	2	....	....	....	....	....	....	....	....	....	....	3363
Narrow.	1	8000	4000	2666	2000	1600	1333	1142	1000	....	....	....
"	2	....	....	....	....	....	....	....	....	1777	1600	1454
Difference in favor of narrow-gauge..		10500	5250	3500	2625	2100	1750	1500	1312	278	250	1909

This table shows that if it is necessary to drop cars with nine tons of freight, at a way station—this being an amount which is one ton over a car-load for the narrow gauge, and which renders necessary the use of two cars at the utmost disadvantage—the dead weight even then is only 1,777 pounds per ton, and still 278 pounds less than the broad gauge.

The operative comparisons would seem to be sufficient to settle the question so far as the economy of the narrow gauge is concerned, but it may be well to look into the question of the reduced wear and tear, in consequence of the use of light machinery and rolling stock. If we assume that the repairs of machinery and rolling stock are in direct ratio to its cost, the reduction for the narrow gauge would be about fifty per cent., which is the difference in the first cost.

The expenditure of power and ordinary repairs should be held strictly correlative, and yet there can be no doubt but that all the parts of the narrow-gauge machinery and rolling stock being relatively stronger, and the shocks to which they are exposed being so much lighter, both cars and locomotives will run with much less repairs than has been generally estimated.

Narrow-gauge locomotives weigh from six to eighteen tons, depending upon the nature of the service they have to perform.

The following table gives the principal dimensions and weights of various patterns and sizes of narrow-gauge locomotives, together with the loads which they will haul on a straight track, in good condition:

Dimensions, Weights and Loads of Narrow-Gauge Locomotives.

KIND OF LOCOMOTIVE.	Cylinders. Diameter.	Cylinders. Stroke...	Diameter of drivers.	Weight in working order. Total....	Weight in working order. On drivers.	Weight in working order. On each pair of drivers.	Load in gross, cars and lading. On a level.	Load in gross, cars and lading. On a 40-ft. grade...	Load in gross, cars and lading. On an 80-ft. grade.	Load in gross, cars and lading. On a 100-ft. grade.
Class 1 Four wheels connected tank locomotive.	9	13	30	18,000	18,000	9,000	390	190	70	55
	9	15	36	22,000	22,000	11,000	490	150	85	70
	10	16	36 to 40	26,000	26,000	13,000	590	180	105	85
Class 2. Four wheels connected with separate tender.	9	13	30	16,000	16,000	8,000	385	115	65	50
	9	15	36	20,000	20,000	10,000	480	140	75	60
	10	16	36 to 40	24,000	24,000	12,000	580	170	85	70
Class 3. Six wheels connected tank locomotive.	10	16	36	28,000	28,000	9,333	615	185	105	85
	11	16	36 to 40	33,000	33,000	11,000	740	225	130	105
	12	16	36 to 40	38,000	38,000	12,666	860	265	150	125
Class 4. Six wheels connected with separate tender.	10	16	36	25,000	25,000	8,333	605	175	95	75
	11	16	36 to 40	30,000	30,000	10,000	730	215	120	95
	12	16	36 to 40	35,000	35,000	11,666	850	255	140	115

Here let us call attention to a matter that bears directly upon the question of "wear and tear," giving a table showing the weight on each wheel of ordinary trains of the two gauges, and the momentum with which the wheel will strike irregularities in the track:

PASSENGER TRAINS, SPEED TWENTY-FIVE MILES PER HOUR.

	Five feet gauge. Weight on single wheel.	Five feet gauge. Momentum...	Three feet gauge Weight on single wheel.	Three feet gauge Momentum...
	lbs.	lbs.	lbs.	lbs.
Engine driver	8,000	288,000	6,250	225,000
Engine truck	5,000	180,000	2,500	90,000
Tender	7,650	174,000	3,500	126,000
Baggage car	4,000	144,000	3,000	108,000
Passenger car	4,780	171,360	1,780	64,080

The ends of the rails are beaten to pieces, the surface abraded, ties splintered, the fibre of the wood cut under the iron, weak joints rapidly made worse, so that each succeeding wheel falls with an increasing force upon the ends of the yielding rails, by the tremendous forces developed by the passage of their enormous weights at high speed. The lightest broad-gauge coach weighs about 16 tons or 32,000 pounds, empty, and hammers the rail joints with 4,000 pounds on each wheel. When loaded and driven over the rails at twenty-five or thirty miles per hour, the weight of the blow is enormous and terribly destructive to the superstructure, crushing out the best rail in five or six years. The passenger car of a three feet gauge would only hammer the rail with 1,500 pounds per wheel. The same truth applies to locomotives. A thirty-ton locomotive, and its loaded tender weighing about seventeen tons, will exert a pressure of nearly six tons on each driving wheel. When driven at a high speed the strain upon the track is terribly destructive.

The "Fairlie" engine, constructed for narrow-gauge lines, bears its whole load, including wood and water, on the driving-wheels, thus utilizing the whole weight in the work of hauling the train. Instead of an engine carrying forty-seven to fifty tons to obtain the power of twenty, we have an engine weighing twenty tons, and no more; and this load distributed over eight wheels, with a pressure of two and a half tons per wheel, instead of nearly six tons, as with the broad gauge. The action upon the rolling stock is the same as upon the track. The wheel receives a blow of precisely the same weight as that which it administers to the rail at a low joint, and the shock is transmitted to the axle, except what is taken up by the springs and the yielding of the parts of the whole structure of the engine or car. The saving of dead weight transported is so much saved from the grand total of this destructive agency, and by the reduced weight upon each wheel no single blow of such enormous force can be given on the narrow gauge. We leave this point with a single illustration, showing the total of the forces expended upon a defective joint on one side of the track, by the passage of a train of fifty passengers, on either gauge. The joint is supposed to have yielded so that the wheels fall into it, with a perceptible shock. In an example selected for calculation, it results that the wide-gauge train will have inflicted a series of blows amounting in the aggregate to 6,891,840 pounds, while the narrow train will have expended a force amounting to only 3,248,640 pounds. Fuel, oil and waste are also reduced in cost, in proportion to the power developed. The list of employees, cost of general superintendence, office expenses, loss and damage, are not estimated.

The percentage of saving in the different departments may be estimated as follows:

Classification of Expenses.

	Percentage of whole Operating Expenses	Percentage saved by Narrow Gauge.....
Maintenance of Roadway—		
Repairs road-beds	.166	.055
Cost of iron for renewals	.129	.065
Repairs, building fences, etc.	.037	.....
Taxes	.088	.....
Repairs of machinery and cars	.20	.070
Operating—		
Office expenses, agencies, and employes on trains and at stations	.123	.....
Fuel, oil, and waste	.125	.041
Loss and damages to goods and persons, general superintendence, etc	.080	.....
Contingencies	.052	.017
Total	.....	.248

The narrow gauge may be operated for about 25 per cent less than the broad gauge, and where the proportion of expenses to gross receipts is 70 per cent, the ratio of the narrow gauge expenses to receipts would be 52½ per cent, and with strict economy probably as low as 45.

The expenditure of power stands in the relation of about 35 to 54 in freights, and 11 to 30 in passenger traffic.

V.—CAN NARROW-GAUGE LOCOMOTIVES BE CONSTRUCTED OF SUFFICIENT POWER AND SPEED TO ANSWER THE GENERAL REQUIREMENTS?

Your committee most unhesitatingly answer yes; and for the following reasons:

1. Because they are doing it daily, and any one who wishes to investigate the question, has only to visit the roads where they are in use and witness the performance.

2. From the fact that the great standard-gauge roads are taking their heaviest freight engines off their lines as fast as it can be done with economy, or as fast as they are worn out, preferring to run more trains rather than the extra heavy ones, because the breakage of draft irons, links, bumpers, and the fearfully costly lamination of the rail, &c., &c., amounts to more than the cost of the additional men and trains.

3. That by adopting the proper form of construction the engines can have sufficient power to handle any number of cars that can be prudently and economically run together in one train, and that such a train can be handled with as much safety on the narrow as on the broad gauge; while the proportion of dead weight being much less, the same number of trainmen will handle more tons of paying freight on the narrow than on the broad gauge when worked up to the same tonnage.

4. All narrow as well as broad-gauge advocates acknowledge that trains can be and are run too fast for the best interests of the roads and the public, and that it taxes them far beyond the bounds of economy to run fast trains.

5. That there is no difficulty in making as fast time with the narrow-gauge locomotive as the great majority of the broad-gauge roads make, which is all the public demands; and that in advocating economy in this particular that we represent the true interests of the public.

6. That the locomotives of the Denver & Rio Grande narrow-gauge railway, freight and passenger, are giving entire satisfaction, both as to freight and power. A seventeen-ton freight locomotive on that road has hauled a train of twenty-four cars with ease up a grade seven miles long, averaging forty feet to the mile—four miles of the same having a grade of seventy-five feet per mile.

GROSS WEIGHT OF TRAIN.

4 empty eight-wheeled box cars, 8,000 pounds each		32,000
12 empty eight-wheeled platform cars, 6,000 pounds each		72,000
8 loaded eight-wheeled platform cars, 6,000 pounds each	48,000	
And load on same, 16,000 pounds each	128,000	176,000
		280,000

pounds, or 140 tons; and this over a new track.

Add the weight of the locomotive, 17 tons, and we have a total gross tonnage of 157 tons.

A twelve-ton passenger locomotive has hauled the following load up the same grades on schedule time, viz.: 15 miles per hour:

5 platform cars, 6,000 pounds each	30,000
And load (rail) on same, 16,000 pounds each	80,000
	110,000

pounds, or 55 tons. Add weight of locomotive and we have a total of 67 tons.

But a still more remarkable performance was that of one of its passenger locomotives, that ran 181 miles with only 2,340 pounds of coal, hauling the usual train of one baggage car and two coaches. Of this distance, 102 miles were run up an average grade of forty feet per mile, and eight miles of seventy-five feet per mile.

The passenger trains on that road have frequently been driven at a speed of thirty miles per hour with perfect safety, and with less oscillating motion than is observable on broad-gauge roads newly constructed.

The construction and practical operations of the Denver & Rio Grande narrow-gauge railway have been carefully examined by experts, and among them numerous advocates of the broad gauge, who all agree that it is a complete success, and that the narrow-gauge locomotive has "sufficient power and speed to answer the general requirements."

VI.—CAN THE PASSENGER COACHES BE MADE SAFE, COMFORTABLE AND POPULAR WITH THE TRAVELING PUBLIC?

The passenger coaches of the European and American narrow-gauge railways are admirably adapted to the respective gauges, of varying proportions and capacity; all agreeing in the most important point, namely, that the proportion of dead weight hauled for each passenger is very much less than in the broad gauge.

The first-class narrow-gauge coaches constructed by Messrs. Jackson & Sharp, Wilmington, Del., and in use on the Denver & Rio Grande Railway, are 40 ft. long, over all, 7 ft. wide inside, 7 ft. 6 in. high, with two 4-wheeled trucks, wheels 24 inches in diameter, weight 12,000 lbs, and carry 36 passengers each. The sills are only 27 inches above the rail, making the center of gravity very low; hence the cars ride exceedingly steady and with less lateral or oscillating motion than is usually observable upon the broad-gauge. The seats are arranged, double on one side, and single on the other, one-half the length of the car having the double seats on the right, and the other half having them on the left, so as to distribute the weight equally. The single seats are 19 inch wide or long; the double 36 inches; the aisles 17 inches. If found desirable there can be no serious objection to increasing the width of the car to 8 ft., making the single seat 22 inches, the double seat 39 inches, and the aisle 23 inches. These cars are finished in the best style; the wood work, the upholstery, decorations, and the whole arrangements being strictly first class.

To enter these cars is to be convinced that the traveler need have no apprehension as to his safety or comfort. In a word, your committee find that it is the opinion of those best informed that they furnish every requisite called for by the first-class coach.

While they will not furnish four seats to a passenger who pays for only one, they will furnish more passengers with a preference of seats than the broad-gauge double seats do, while the seats are in every respect as comfortable. The cars being smaller, railway officials can equalize the seats to the number of passengers much better than with the broad-gauge, thereby saving largely in dead weight, wear and tear and the consequent cost of maintenance.

Sleeping coaches, with a single berth on each side, can be constructed so as to be as comfortable as those now in use, and at the same time have the ratio of dead weight very much in favor of the narrow-gauge.

In view of the practical facts enumerated, your committee unhesitatingly affirm that "the narrow-gauge passenger coach" is as "safe and comfortable" as the broad-gauge, and that this being the case, that they will become "popular with the traveling public," especially as narrow-gauge railways, from their small cost, can and will furnish lower rates of fare than the broad gauge.

VII.—CAN FREIGHT CARS BE CONSTRUCTED OF CONVENIENT SIZE FOR THE TRANSPORTATION OF COTTON, LIVE STOCK AND GENERAL FREIGHTS?

The Denver & Rio Grande Railway are now doing a general freight and passenger business, and are carrying live stock, wool, lumber, and in fact every class of freight; and their officers give it as their unreserved opinion, founded upon actual experience, and which is concurred in by connecting roads, that they gain in every case where the size of the car comes in question, and that in no case is the extra room of the broad gauge car equal to the loss in dead weight. This applies to every class of cars on the roads with which the Denver & Rio Grande connects.

They carry nine of the largest cattle in a car weighing less than 8,000 pounds, while the broad gauge carry only fourteen of the same class in a car weighing from 18,000 to 20,000 pounds. The Denver & Rio Grande cars have four-wheeled trucks, are twenty-four feet long, the doors being at the side, but near the end, instead of the center, and on the opposite side of the other end. For heavy and valuable cattle they have two gates in the car (which when not in use are folded back against the side of the car), which makes three rooms 6x8 feet, into which they put three head of stock each, giving a space of 2x8 feet to each head.

The broad gauge puts 14 head of the same cattle into a 28-foot car, which gives the Denver & Rio Grande and other narrow gauges the same floor room that the broad gauge has, and with much less dead weight.

COMPARATIVE DEAD WEIGHT IN THE TRANSPORTATION OF CATTLE BY THE TWO GAUGES.

Broad Gauge.

Weight of car in pounds	18,000
Number of cattle per car	14
Weight of cattle in pounds	19,600
Gross weight of loaded car	37,600
Dead weight per head	1,285

Narrow Gauge.

Weight of car in pounds	8,000
Number of cattle per car	9
Weight of cattle in pounds	12,600
Gross weight of loaded car	20,600
Dead weight per head	888
Dead weight in favor of narrow gauge	397

A difference of 397 pounds per head, 3,573 pounds per car load of 9 head, and in a train of 20 cars 71,460 pounds, or 35 tons in favor of a narrow gauge.

Prominent stock men now say that they would prefer to send their stock to market in such cars as the Denver & Rio Grande furnish, because it does not put so many together, and that the danger of cattle getting down is much less, while they can be fed and attended to much better.

We will treat of the transportation of cotton under the next head.

VIII.—WHAT SAVING IN DEAD WEIGHT WILL THE NARROW-GAUGE EFFECT?

Under this head your committee desire to call attention to the fact as set forth by Mr. Fairlie, namely, that the East India narrow-gauge cotton car, weight 3,000 pounds, carries 10,800 pounds of cotton or paying freight, while the Southern broad-gauge box car, weight 18,500 pounds, carries only eight tons, or 16,000 pounds.

Assuming that the cotton trains on our Southern railways average twenty-five cars per train, let us see how the narrow gauge will compete with the broad gauge in the transportation of the great staple of that section when moved in the standard English cotton car, and in order that we may be able to load the broad-gauge train to its full capacity, we will assume that the cotton is compressed.

COMPARISON OF COTTON TRAINS.

Broad Gauge.

Weight of single car in pounds	18,500
Number cars in train	25
Total dead weight of cars in pounds	462,500
Total paying weight in pounds	400,000
Gross weight broad-gauge train in lbs.	862,500

Narrow Gauge.

Weight of single car in pounds	3,000
Number cars in train	37
Total dead weight of cars in pounds	111,000
Total paying weight in pounds	400,000
Gross weight narrow-gauge train in lbs.	511,000
Gross weight broad-gauge train in lbs.	862,500
Difference in favor of narrow gauge in lbs	351,500

A difference in favor of the narrow gauge of 351,500 pounds, or 175 tons.

We will now see how they can compare when loaded with uncompressed cotton, which is the condition in which it is usually shipped. The common broad-gauge box-car of the South has a floor area 27 by 8 feet—216 square feet—weighs 18,500 pounds, and carries 24 bales, weighing 450 pounds each. The paying freight carried per car is 10,800 pounds, and the dead weight 18,500 pounds; or for each bale weighing 450 pounds, we haul 770 pounds dead weight.

The narrow-gauge box-car has a floor area of 162 square feet, weighs 8,000 pounds, and will carry 18 bales cotton weighing 8,100 pounds, or 444 pounds dead weight per bale, against 770 pounds by the broad-gauge.

COMPARISON OF TRAINS WITH UNCOMPRESSED COTTON.

Broad Gauge.

Weight of single car in pounds	18,500
Number of cars in train	25
Total dead weight of cars in pounds	462,500
Total paying weight in pounds	270,000
Gross weight broad-gauge trains in pounds	732,500

Narrow Gauge.

Weight of single car in pounds	8,000
Number cars in train	34
Total dead weight of cars in pounds	272,000
Total paying weight in pounds	270,000
Gross weight narrow-gauge trains in pounds	542,000
Dead weight in favor of narrow gauge	190,500

A difference in favor of the narrow-gauge of 190,500 pounds, or 95 tons.

We find then that the narrow gauge has largely the advantage in all cases, and that

The Narrow-Gauge Eight-Wheeled Box Car,

weight four tons, capacity eight tons, or a total of twelve tons, weighs when loaded only two tons more than the heaviest broad-gauge box car when empty.

That the Narrow-Gauge Eight-Wheeled Stock Car,

weight four tons, capacity nine head (largest cattle), or twelve thousand six hundred pounds, weighs when loaded only six hundred pounds more than the heaviest broad-gauge stock car when empty.

That the Narrow-Gauge Eight-Wheeled Platform Car,

weight three tons, capacity eight tons, or a total of eleven tons, weighs when loaded only two tons more than the heaviest broad-gauge platform car when empty.

That the Narrow-Gauge Eight-Wheeled Passenger Coach,

weight six tons, capacity thirty-six passengers, or in round numbers, a total of nine tons, weighs six tons less than the average of broad-gauge coaches empty.

Further argument upon this point would seem unnecessary.

IX. How will the saving in first cost and dead weight effect the rates of freight and passage?

We have at this time about 60,000 miles of broad-gauge railway in operation in the United States.

These railways have cost from $20,000 to $60,000 per mile; estimating their average cost at $40,000 per mile, they represent $2,400,000,000. Had we originally adopted the narrow-gauge at half the cost of the broad, the expenditure would have been $1,200,000,000, leaving an equal amount for investment in manufactures or other enterprises.

Or with the $2,400,000,000 invested in the narrow gauge, it would have given us 240,000 miles in active operation to-day. It needs no argument to demonstrate that if we had double the number of miles in operation that we now have, that our resources would be developed much more rapidly than is now being done.

Neither does it need any argument to prove that had our railways cost us only from $10,000 to $20,000 per mile, that it would have cost less to operate them, and that our general interests would have been advanced in a corresponding degree.

The cheaper the first cost of the road, machinery and rolling stock, provided they be ample for the business offering, the lower the rates, and the consequent rapid development of all interests.

The great want of the age is cheaper transportation, and this we cannot have without cheaper railways.

The average cost of transporting freight by the broad gauge may be estimated at 1½ cents per ton per mile, and on the narrow gauge 1 cent. One ton transported 200 miles, at 1½ cents per ton per mile, will cost $3, and at 1 cent $2—a saving of $1, or 33⅓ per cent. in favor of the narrow-gauge.

Estimating the cotton crop of the Southern States at 4,000,000 bales per annum, and the average cost of transportation at $3 per bale, we pay $12,000,000 freight per annum on this one product alone.

Admitting that the cost of transportation by the narrow gauge would be one-third less than by the broad gauge, it would effect a saving to the producers of $4,000,000 per annum, or, for a period of twenty-five years, $100,000,000—a sum sufficient to build 10,000 miles of narrow-gauge railway at $10,000 per mile, or 5,000 miles at $20,000 per mile.

The East India Company, looking to the extension of the cotton culture in their territory, have projected 10,000 miles of narrow-gauge railway, and that too in a country far more densely populated than ours, and offering a large general business. In addition to this they are changing some of their broad-gauge lines to narrow gauge, in order to reduce the cost of transportation on cotton, so as to be able to compete with us in the production of that great staple.

The East India cotton planter commands an almost unlimited supply of the cheapest, most patient and easily controlled labor in the world.

This, with their system of cheap narrow-gauge railways, with its low rates of freight, make them dangerous competitors, and it is a serious question, and one well worthy of our earnest consideration, whether, with our dear labor and high broad-gauge rates, we can continue to maintain our supremacy in this branch of industry, without cheaper transportation than we now have.

The great West and Northwest, with their vast agricultural productions, demand cheaper transportation than the costly broad-gauge railways can possibly furnish them. They demand transportation so cheap that points now so far distant as to be unable to ship their corn, and hence use it for fuel, will be able to enter the markets of the world with the products of their labor. The demand is a just one, and should be complied with. It is a want that the great masses of the people are deeply interested in—that of cheap food.

Your committee might with propriety discuss this question at great length; but, as it is self evident that railways costing only from $10,000 to $20,000 per mile, can work comparatively than those costing from $20,000 to $60,000 per mile, there can be no question of their effecting a large saving in both the "rates of freight and passage."

X.—BREAK OF CONNECTIONS.

The time of transferring freight need be but very little if any greater than is now necessarily consumed in the inspection and repair of cars, at intermediate points, which are sent over long lines. The shipper can well afford a slight delay, if thereby he saves largely in cost of shipment.

Experience has demonstrated the cost of transferring freight in Great Britain to be about 2 pence per ton. The cost on the Canada frontier has been found to be, from many years' experience, 5 cents per ton. Considering it as a question of cost, it will evidently bear heaviest upon through freight, which has to be changed at each end of a line, at a cost of 5 cents per ton, or a charge of 10 cents per ton total. The average cost of transporting freight may be taken at 1½ cents per ton per mile on the broad gauge, but on the narrow gauge we find that we can transport 25 per cent. cheaper in actual working expenses.

One ton transported 200 miles, at 1½ cents per mile, would cost $3, and a saving of 25 per cent. on this would be 75 cents, so that an expense of 10 cents per ton may be incurred in transferring freight, and still leave a balance in favor of the narrow gauge, or shipper, of 65 cents per ton, $6.50 per car-load of ten tons, or $162.50 for a train of twenty-five cars. Further argument is deemed unnecessary upon this point.

XI.—THE EXPERIENCE AND OPINIONS OF EXPERTS.

Reference has been already made to the practical workings of the Denver & Rio Grande Railway, as well as the convictions and opinions of its officers, all tending to show conclusively that the narrow gauge has ample capacity for the business of any line on this continent.

But we will quote the testimony of other professional authorities and experts:

The annual report of the Festiniog narrow-gauge (1ft. 11½in.) railway, for 1869, shows that it transported 136,132 tons net, and 97,000 passengers that year. Gross tons hauled, exclusive of engines, 242,000.

The total receipts for the year 1869 were	£23 676
Expenditures	13,053
Net income	£10,623

or nearly 50 per cent.

In Norway railways of the 4ft. 8½in. and 3ft. 6in. gauges have been constructed by the same engineer, and worked by the same manager, for the government, and the following statistics are taken from the government returns, showing the average from six years' experience:

	Gauge 4ft. 8½in.	Gauge 3ft. 6in.	Difference in favor of the nar. gauge.
Cost of construction per mile	$36,343	$17,143	$9,200
Receipts per mile (alike)	27,600	27,600	....
Maintenance per mile	7,173	6,565	608
Locomotive expenses per mile	9,425	5,759	3,666

Mr. Spooner, Engineer and Superintendent of the Festiniog road, under date of December, 1870, gives the following opinions:

"From my experience in working the 1 foot 11½ inch gauge I deduce the following, to show the sufficiency of the 2 feet 9 inch gauge.

"1. That the cost in construction, in earthworks, bridges, tunnels, etc., depends on the gauge.

"2. That the cost of maintenance of rolling stock will be low consequent upon the small weight on each wheel.

"3. That a speed of forty miles per hour can be run with ease and safety."

Mr. Spooner's opinion is of special value, as the study of this subject has been his occupation during ten years; and, as his experience has been more full than that of any other person, so is his knowledge of the matter more profound.

In June, 1869, the British government appointed a commission of engineers and railway experts to consider what gauge should be adopted for the Indus Valley and other projected railways in India.

We quote from the majority report: "It is manifest that lines on this gauge (3 feet 6 inches) are worked with as much convenience to the traffic as on any broader gauge, and vehicles may be used on this gauge which will afford complete accommodations for all classes of passengers and freight."

XII.—THE NARROW GAUGE, AS COMPARED WITH THE BROAD GAUGE, AS THE MEANS OF DEVELOPMENT.

This is a question of vital importance, and one that affects all interests alike. This being the case, any system that will afford ample facilities for transportation at reduced rates is a public blessing.

The necessarily high rates entailed upon us by the excessive cost of the broad gauge might have been avoided by the adoption of the narrow gauge with its small cost, light operating expenses, small interest account and low rates.

A most striking instance is that of the Southern States, whose vast and inexhaustible supplies of coal and iron, unsurpassed for their purity and richness and the ease and cheapness with with which they can be mined and worked, but which, from the high broad-gauge rates of transportation, remain locked up in their hills and mountains.

A cheap system of railways, with its low rates of freight, would have long since developed those interests, enriching that section, and adding vastly to the general wealth of the country.

The great West and Northwest, with their broad prairies and vast plains, unequaled for their general productiveness and the ease with which they can be tilled, also feel the incubus of high rates of transportation entailed upon the products of their labor from the same cause.

The reduction of rates which would follow the general introduction of the narrow-gauge system would add millions of dollars per annum to their incomes, and at the same time largely benefit the consumer.

General development can only be accomplished by an extended system of railways.

Quick development can only be attained by cheap trasportation. We may therefore conclude that the narrow gauge railway is by far the best means for a general and quick development of our resources, for the following reasons:

1. Costing only about one-half as much as the broad gauge, it is within the means of all sections to build them, hence will enable them to avail themselves of railway facilities where otherwise they will be compelled to dispense with them.

2. From their small cost, light operating expenses, and small interest account, they will prove to be paying investments.

3. They will supply the great want of the age—cheap transportation.

4. Cheapening transportation, they will develop dormant interests more rapidly than our present costly structures with their high rates can possibly do.

5. Their general adoption in sections without railway facilities will enhance the value of properties largely in excess of their cost.

6. Penetrating those sections, and rapidly developing their resources by low rates, they will bring a large new business to the broad-gauge roads, enabling them to reduce their rates, and thereby stimulate old and develop new interests.

7. A failure to adopt the narrow gauge in the sections referred to will necessarily defer the construction of railways until such time as their means will admit of the more costly broad-gauge, with its consequent high rates.

COMMITTEE.

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